THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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SCIENCE AND THE NATION.

NOTHING in our social organisation is more incomprehensible to the man of scientific training and pursuits than the indifference which is manifested towards the nature, potentialities, and purposes of scientific culture by the great mass of the people of this country. Having himself tasted the delights of the search for truth and the endeavour to promote the progress of mankind, be it in the humblest capacity, he sees the world with different eyes, from a new point of view; and not as a contemptuous Pharisee, but as the brother of all humanity he wishes all to share in the riches which he has discovered. But it is given to few to cast their knowledge in a form attractive to the public; Faraday, Tyndall, Huxley, Ball, and some others were able to do so, but the gift is rarely met with nowadays, and partly in consequence of this the people display even less interest in science to-day than they did 20 or 30 years ago. We do not blame the modern teachers for their inability to emulate the genius of the great men of the past; if they have not the gift of popular exposition, they are undoubtedly well able to enthrall the minds of those who come to their lectures properly prepared to assimilate their teaching, and fired with the desire to learn; it is not the want of teachers that we suffer from, but the lack of learners.

No one who has observed the popular tendencies during the past quarter of a century will deny that there has been plainly manifest a craving for amusement and frivolity, for slothful ease and sensual pleasures, a drifting away from the spiritual towards the material. A similar phenomenon marked the days of the decline of the Roman Empire, when the populace demanded "Bread and games," and cared for nought but the gratification of their various appetites, while destruction crept upon them. Not that we anticipate a similar fate for this gracious realm—*absit omen!*—but we see in this tendency to unrestrained enjoyment the symptoms of decay, which, if not arrested, would undoubtedly destroy the nation.

From this point of view, we may be thankful for the war—the knife which, clumsily and brutally applied by a jealous rival in the hope of achieving our destruction, bids fair to accomplish our salvation by awakening us to our danger and ending the too easy prosperity which was lulling us to slumber. It is a sharp medicine, as King Charles said of the axe—but desperate diseases need desperate remedies.

Now, there are many reasons which induce us to hope that one of the greatest benefits that we shall derive from the war will be the adoption of a new attitude towards science by the nation. Hitherto there has been a tendency to look upon a man engaged in scientific pursuits as unpractical, absent-minded, and aloof from the world of affairs; but those who harbour this unjust impression are gravely in error. We are fortunate in having amongst us many men in the front rank of scientific progress—whose work has attained a world-wide reputation amongst those who are in a position to appreciate its worth, and who are full of vigour and eagerness to serve their country. They recognise that in the present crisis of our fortunes their special qualifications for research may and should be utilised to the utmost,

and they are anxious to seize the opportunity of promoting the welfare of the nation. Many of them have, in fact, devoted their talents to the national service from the commencement of the war, and the Government, after long delay, has realised the necessity of mobilising our scientific forces with a view to making up for lost time and engaging our enemies upon their own ground. While the Germans are pre-eminent in the application of scientific method to the needs of industry, they are by no means noted for initiative or creative ability, of which we have no lack; they are, in fact, but uninspired plodders, and if we utilise our resources with sound judgment and efficiency, we need not fear defeat.

Unfortunately, we are governed by a coterie of lawyers, whose whole training has been utterly divorced from science, and who are inherently incapable of appraising the merits of a scientific discovery or the capabilities of scientific men. Only by the most strenuous efforts of such men as Sir William Ramsay was the importance of withholding cotton from Germany brought home to the nation, and their efforts would have been of no avail without the powerful assistance of the Press. But a few weeks ago a prominent member of the Government announced as *a new discovery* the fact that glycerine was derived from oils and fats. Labouring under their life-long prejudice against all physical science, a prejudice that was implanted in their minds at public schools controlled by literary men to whom science was anathema, and hugging the delusion that science is unpractical—whereas it is essentially the most practical form of knowledge—our rulers organise an Advisory Council and place it under the control of executive officers who, with the best will in the world, are nevertheless hopelessly unable to administer a scientific department with any approach to efficiency. With sublime assurance, however, the politicians consider themselves qualified to take charge of any Department of State without previous training, and flit from the Board of Trade to the Exchequer, from the War Office to the Woolsack, or from the Post Office to the Department of Agriculture, with equal ease and incompetence. Surely it is high time that our methods of Government were drastically reformed. At the present moment we have a Labour representative at the head of the Board of Education—which, like the Board of Trade, and the Local Government Board, is an unreal body that never meets.

Whether in the absence of a complete change of system in the appointment of our governing body it will ever be possible to bring about that fundamental reform in the utilisation of science for the benefit of the nation that is so urgently necessary, we do not know; but we are sure that the mere appointment of advisory councils, inventions committees, etc., will never take us very far in the desired direction. What is required is a change of attitude on the part of the nation as a whole. Our "leaders" unblushingly declare that they only follow public opinion; it is the latter, therefore, that must be first reformed, and in effecting this object the Press can render invaluable assistance. In an interesting address delivered in October last, Prof. Fleming drew attention to the question, and pointed out that we had still made scarcely any progress towards the creation of a disciplined army of scientific workers, and urged the formation of committees of scientific specialists to guide and instigate research, the reading and discussion of papers on problems of the moment by our engineering and other societies, and generally the promotion of a higher efficiency in all our operations. "We have said good-bye now and for ever to those easy-going amateur British methods which have held us in the past." Let this be our watchword—let us be strenuous and unwearied in furthering the scientific education of the nation; let us think less of our individual interests and more of the immense power of co-operation and mutual aid.

Copper. There has been some irregularity in the tone of the standard copper market owing to the gloomy outside conditions, and to the fact that an anxiety to realise paper profits manifested itself. The downward movement in prices in the speculative medium naturally affected the position of consumers, who, as soon as they thought they could detect growing weakness in the position, abstained from buying. Consequently, there has been less new business booked on this side, although consumption is proceeding at a remarkable rate. A new feature which has developed has been the refusal of the authorities to permit any shipments of standard copper abroad. The reason for this is to be found in the substantial reduction which has been effected in the holdings of rough metal here during the last few months. So long as there was a sufficiency of standard copper to provide for the reasonable requirements of consumers in this country the authorities were not unwilling to allow exports from here to America on an undertaking being given that the refined material should be brought back to this country, but this is no longer regarded as good policy owing to the smallness of the stocks now available here.

There is no change in the position of the leading producers, who, in fact, show remarkable firmness all round. There is a tendency to believe that American production is barely equal to the huge war demands combined with the growing domestic consumption across the Atlantic for general purposes, but the latter is bound to be affected sooner or later by the excessively high prices ruling, though the same consideration does not apply in so far as war requirements are concerned. Producers are very well sold, and, indeed some of them have nothing to dispose of now for the next two or three months except possible odd parcels. The tone has been a shade easier, perhaps, so far as refined copper is concerned, but this appears to be due to nothing more serious than a disposition on the part of second hands to realise a portion of their holdings which shows them very substantial profits.

Buying lately has been of a less aggressive character, consumers on both sides of the Atlantic appearing rather to have satisfied their needs for the time being, and to be disposed to hold their hands pending some fresh development in the general situation. There has been some interruption in the supply of rough copper to the American refineries, and this would appear to have been the foundation for the spurt in prices which lifted electro in New York to 20 c. per lb. f.o.b., and in this country to £99 a ton c.i.f.

There was rather a nasty labour outbreak at one of the largest refineries there which caused an entire suspension of operations for about a couple of weeks, and this completely frightened buyers, while the supplies of material available for treatment at the refineries were likewise cut down owing to fresh trouble in Mexico, and to the continued strike in Arizona which closed down practically the entire copper production of that State. Important modifications have, however, now occurred in Arizona and Mexico, while the strike at the refinery alluded to proved of comparatively short duration. Work is proceeding at full tilt in all directions of the American copper trade.

Importing Machine Tools. Users of machine tools have been somewhat mystified by the recent Royal Proclamation prohibiting the importation of these appliances into the United Kingdom, except under licence from the Board of Trade, as from December 21st next. At first glance it is difficult to reconcile this restriction with the extraordinarily heavy demand for machine tools from firms engaged upon munition work, and the avowed difficulty of sellers in coping with this demand. An investigation of the causes which led to the step, however, discloses a remarkable state of affairs. Throughout the country many small firms, which were formerly unknown in the tool trade, have suddenly come into existence, and have been importing second-hand machine tools and selling them

at inflated prices. The tools in question have invariably proved faulty, and such inconvenience was caused by this as to attract the attention of the authorities, with the result that the Proclamation now issued restricts the importation of machine tools, except under licence from the Board of Trade.

These licences will only be granted to firms which were established in this country not less than two years before the outbreak of the war, and whose turnover amounts at least to £10,000 per annum. Imports licences will be granted to firms satisfying these requirements subject to the condition that the tools shall not be sold to users at a profit exceeding 18½ per cent., or in the case of transactions between one merchant and another, at a profit exceeding 10 per cent. The effect of this arrangement will be to eliminate the small and irresponsible trader, and to limit the business to reputable and experienced firms. The sale of second-hand machine tools is likely to be affected very considerably by the restriction, but, on the other hand, it is expected that business in new tools will be stimulated. The prohibition does not apply to hand tools.

Nationalisation of Electricity Supply in Germany.

The question of the establishment of a Government monopoly of the supply of electricity in Germany was raised incidentally on November 24th at a meeting of the Berlin Electricity Works Co., when Dr. Walter Rathenau, criticising certain figures adduced on behalf of a minority of the shareholders with a view to showing the great future prospects of the undertaking in its new sphere of activity, stated that the estimates had no foundation, especially having regard to the monopoly endeavours of the Government. Apparently this reference applied to the Imperial Government, or rather to that of Prussia, as at least two of the Federal States propose to act independently on their own account, one being an entirely new scheme, and the other the development of a project which has been under consideration for a long time past. The former relates to the kingdom of Saxony, and information concerning it is contained in the Address from the Throne at the opening of the Saxony Parliament on November 11th. It was therein stated that the supply of electricity in the kingdom urgently needed to be consolidated and unified, and the Government had therefore decided itself to take in hand an undertaking of such great importance to the whole national economy, and the impending introduction of a Bill for this purpose was foreshadowed. The second instance refers to Bavaria, where the Ministry of State placed before the Finance Committee of Parliament on November 23rd a detailed report on the position of the work for the establishment of the Walchen Lake works for the supply of electricity to the whole of Bavaria. The report is based upon the information furnished by Imperial Councillor Muller, and the Ministry endorses the suggestion that the most appropriate site for an embankment installation is near Krünn. It is proposed to form a special company under the title of the Bavaria Works, to carry out the project, which also provides for a combination of the large power works in Rhenish Bavaria. The overland and large power stations already existing in Bavaria, together with the electricity works in towns and communal supply districts, come into consideration as customers for the new works. It is estimated that the Bavaria Works, which will have a feeder network at 100,000 volts, will have to expend £1,550,000 on the network and accessory plant, of which one-half will be raised by a loan bearing a fixed rate of interest, whilst the other half will form the company's working capital. The proprietors will be the State, the overland central stations, the towns—which will be able to participate at least for the amount of the capital expenditure which they will not have to incur for extensions of their own generating stations—and the firms entrusted with the establishment of the network, who will be interested to the extent of a portion of the constructional expenses devolving upon them. It is calculated that with a total annual consumption of 630,000,000 KW.-hours, which will be reached in the next 10 years, a yearly saving of £210,000 will be effected by the consolidation of interests in the Bavaria Works, as compared with individual supply from independent generating stations. The interest of the Government in the scheme is of a twofold character. In the first place, it is hoped by its successful completion to afford important advantages, through a cheap supply of light and power, to industries and agriculture, which are expected to develop after the war; and, secondly, it is calculated that the hydro-electric works, of which the Gustav Works now in progress at Dettingen is a preliminary example, will also be available in connection with the conversion of the Bavarian State railways to electric traction. It is intended, if sanctioned by Parliament, to begin the undertaking immediately on the conclusion of peace, as negotiations are already proceeding for this purpose.

The Decimal System.

In our "Correspondence" columns to-day Mr. C. Turnbull raises a point of considerable importance with regard to the teaching of the metric system in our elementary schools. Impressions gained in childhood are apt to endure throughout life, and nothing could be more detrimental to the popularity of the metric system than to have it made the subject of abstruse and puzzling problems by misguided teachers. Rarely indeed would anyone require to convert from one system to the other; and when conversion was absolutely necessary, it would be effected with ease by means of the admirable tables which are available. We can quite imagine that if "teaching the metric system" is taken to mean arithmetical gymnastics, irreparable harm will be done to the opinions of the rising generation. As a matter of fact, the true teaching of the system would involve not more than a morning's work—there is so little to learn.

With regard to M. Planchon's letter, while we appreciate the ingenuity of his proposal, we maintain our view that the English sovereign must on no account be interfered with. It has been for centuries our standard coin, and is known throughout the world, while all our statistics have been recorded in terms of it; we must not touch the pound! We do not agree that with the pound and shilling we can form a decimal system; the retention of any multiplier other than 10 is absolutely fatal to the simplicity of the system. In our view the pound, florin, and mil (or modified farthing) are the essential coins, and all the gold and silver coins now in circulation would be entirely unaffected in value.

We may add that just as the French centime and the German pfennig are coins too small in value to be of practical use, so the $\frac{1}{100}$th of a shilling would be a merely nominal coin, whereas the mil, being practically equivalent to the present farthing, would probably enter into circulation on its own merits, as at present.

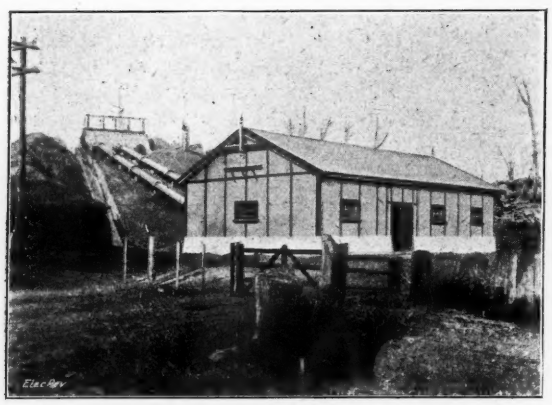
Our contemporary the *Contract Journal*, in further commenting on our recent articles, whilst adopting a complimentary tone which we cordially appreciate, is unfortunately unable to agree that the adoption of metric measures and decimal coinage in this country has much bearing on our foreign trade. But, in order to prevail in the stress of modern competition, we must neglect nothing that will strengthen our arms or reduce our costs, and there is no doubt whatever—*pace* our contemporary—that under our present system of £ s. d. a vast amount of clerical labour is absolutely wasted. *We cannot afford to waste it.* But our manufacturers cannot cut loose from it unless everyone else does too. And as regards the metric system, here again we cannot use both; efficiency can only be attained by the employment of a single universal system.

The essence of economical manufacture on the great scale is to be sure of your home market first, and send your surplus abroad; and if the surplus must be metric, the *whole* must be. In short, the adoption of the metric system at home is the necessary preliminary to its adoption for export, and we entirely dissent from the view that its advantages "can be obtained by individual effort."

A NEW ZEALAND HYDRO-ELECTRIC SCHEME.

It is not usual to read of a power scheme over 2,000 ft. above sea-level, but there is such a one on the main trunk line in New Zealand, at a rising borough called Ohakune, which a few years ago was only a bush settlement. Ohakune, like many other towns in New Zealand, is situated close to a river, the Mangawbero, which, it was discovered, had enough fall for producing a sufficient supply of electricity for lighting and power purposes to meet the requirements of the town for some years to come.

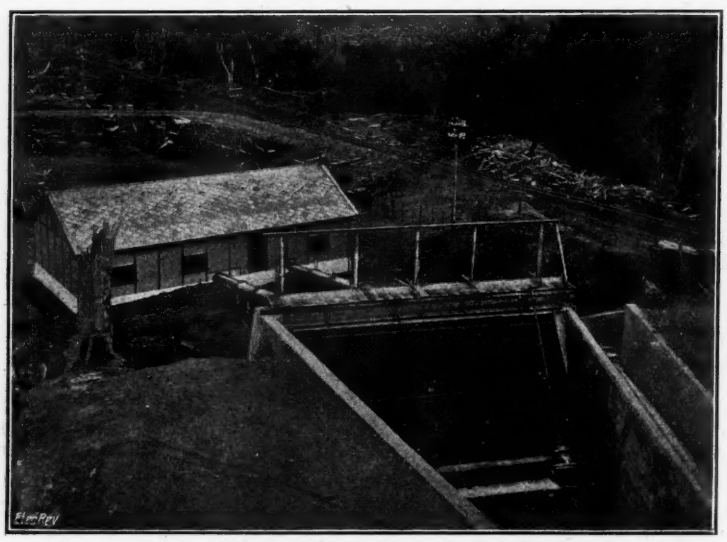
A low rubble dam was thrown across the river, and the water diverted through a screened regulating gate into the flume, which conveys it to the power station, less than half



Power Station and Pipe Lines, Ohakune.

a mile distant. The flume has a fall of 1 in 1,200 throughout its length, and is constructed principally of concrete. Where the flume crosses under the roads it has been roofed over with ferro-concrete, and where it is carried over creeks or on artificial fillings timber fluming has been used.

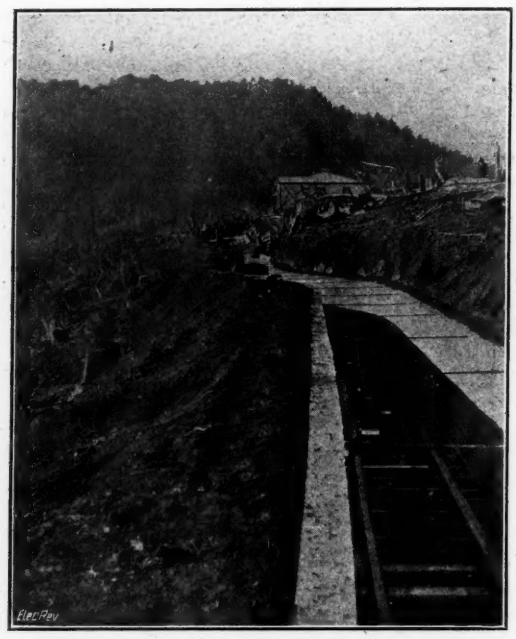
At the extreme end of the fluming the water enters the forebay; this is designed with a long spillway capable of taking all the water the flume can carry—viz., the equivalent of 250 H.P. When the turbines are not in use, the



Forebay Screens, Spillway and Power Station.

water discharges over the spillway into the underground tail-race leading into the river. The forebay is fitted with a sludge valve, which can be used for discharging into the tail-race any silt which comes down the flume. Screens are also provided for holding back any *débris* which might injure the turbines. From the forebay two penstocks of riveted steel, each 27 in. in diameter, convey the water to the turbines in the power house below, and provision has been made for the installation at a later date of a stand-by unit.

The present plant consists of two reaction Francis-type turbines, made by Messrs. Boving & Co., each capable



Concrete Flume with Truck Rails Inside.

of giving 100 B.H.P. under a total head of 40 ft. with a normal speed of 600 R.P.M., and each is controlled by a Boving patent automatic oil-pressure governor guaranteed to control the turbines with a momentary variation of speed not exceeding 3 per cent. with 25 per cent. change of load, 6 per cent. with 50 per cent. change of load, and 15 per cent. speed variation with full load thrown on or off. The fly-wheels are of cast steel, proportioned to prevent a pressure rise in the pipe-line exceeding 40 per cent. of the normal, when full load is suddenly thrown off the turbines.

Each turbine is coupled through a flexible coupling to a 60-K.V.A., three-phase, revolving-field alternator, generating at 2,400 volts and 50 periods. These alternators are star-connected, with the neutral terminal earthed. An exciter is direct-coupled to each shaft. The alternators, as well as the switchgear and instruments, were manufactured by the British Westinghouse Co.

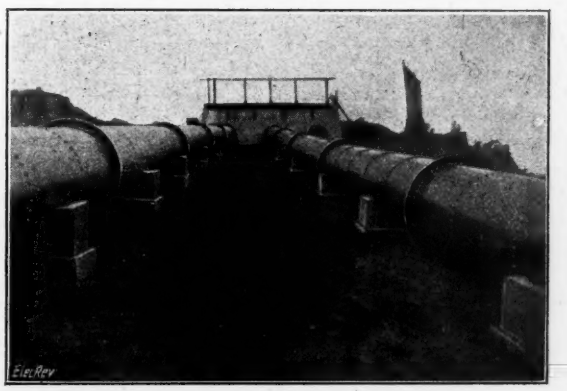
The switchboard is fitted with all necessary instruments for indicating the current supply, and the machinery is effectively protected by Westinghouse lightning-arresters placed on the wall behind the switchboard; isolating switches are also fitted to the outgoing feeders.

An ideal natural storage of water is available with the expenditure of very little capital. This consists of diverting the Mangawbero into an extinct crater (for Ohakune is surrounded by mountainous country) situated a few hundred yards upstream from the intake.

The power-house building is about 50 ft. long by 24 ft. wide. The foundation walls are in concrete raised 2 ft. 6 in. above the ground-level, and the superstructure consists of a timber framing lined inside and outside with Poilite.

The main streets of the town have been reticulated for private and street lighting. The poles used throughout are of natural round Australian ironbark, the cross-arms being

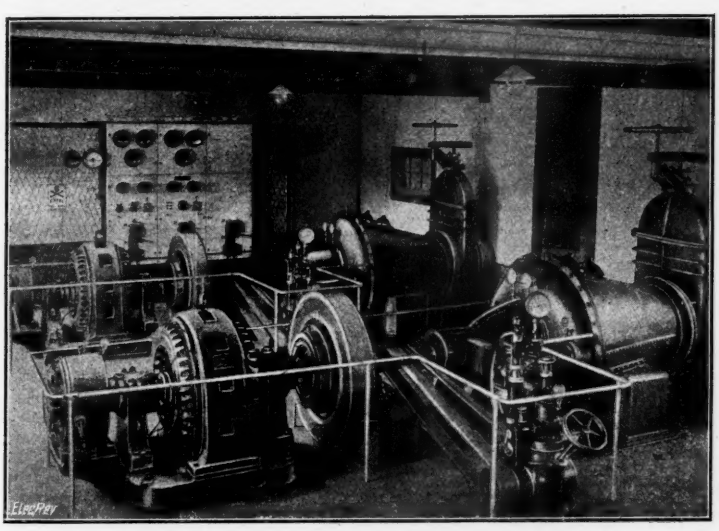
of best North Island Rata. The reticulation system is fed at 230 volts for lighting and at 400 volts for power, from one 20-KW., two 10-KW., and a 5-KW. transformer, mounted on poles at different parts of the town. A large number of street lamps, each of 50 C.P., have been provided. The



PIPE LINES AND FOREBAY.

brackets used are of very neat design, with special reflectors.

The Borough Council is assisting ratepayers who are not in good financial circumstances to install their premises on a monthly time-payment system; the Council raised



INTERIOR OF POWER STATION, OHAKUNE, NEW ZEALAND.

a loan of £9,000 for the purpose of installing the plant. On account of the height at which it is situated, and other unique features, the scheme has attracted considerable attention. It was designed and supervised by a well-known firm of New Zealand electrical engineers, Messrs. Turnbull and Jones, whose representative in the scheme was Mr. S. Blackley.

BRITISH INDUSTRY AFTER THE WAR.

IN his Presidential address to the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, Mr. H. B. Rowell, after discussing some of the engineering features of the war, referred to the industrial situation, and remarked that the position would be very serious at the conclusion of the war.

The ignorance in which the country had been kept, the courtier-like deference of the Government to labour, the high rates of wages, defiance by labour of supervision, demoralisation caused by unmoral methods of payment, excessive overtime, night and Sunday work with their accompanying abuses, had all combined to produce a condition of affairs which could not possibly continue.

Taking the most favourable assumption that victory came to us and our Allies, the relative position of this country and her competitors after the conclusion of peace would not necessarily be to our advantage. We should go into the commercial arena with labour costs much higher than at any time in our history, and probably at a great disadvantage from the point of view of delivery and internal industrial troubles; while Belgium, Germany, and Austria, in the throes of industrial starvation, and with favourable labour conditions from the point of view of competition, would set to work more methodically and resolutely than ever to recover their positions in the markets of the world.

For a number of years workmen had been encouraged to believe that, as regards production, their interest was divergent from that of their employers, and that the former could best be served by limiting the amount of work done in a given time. Since the war began loyal efforts had been made, especially by those of the men's leaders who had visited the fighting line, to suspend the influence of this teaching, but the success attending these efforts had been far from complete. It had never yet, apparently, occurred to these men that the amount of money a man could receive in wages could only be a proportion of the value of the work he turned out, and that it was not likely to be increased in the long run by limiting the output of the individual workman.

With the value of the annual output per man in American works about two to three times that in this country, and the use of machinery per head showing a similar ratio, it seemed that increase of output indicated the direction in which we must look for the salvation of our industries and the increased welfare of our men.

It was absolutely essential that the men should be brought to see that their first interest was the fostering of the industry by which they lived, and that the limitation of output was a fallacy which had done more than foreign bounties and Protection to foster shipbuilding abroad. Increase of output and economy of production reacted on each other, and the interest of employer and employé in both was inseparable.

However the war might end, it would have one outstanding result—a marked change in the attitude of all departments and sections of the Government towards the trade and manufactures of this country, and towards education as bearing on these; it was quite comprehensible that the political representative of this country might consider that he could not properly assist a particular British subject to secure an order, but it was wrong that he should not realise that it was of first importance that the country he represented should secure it.

The work which was being done by the new Ministry of Munitions, aided, as it was, by business men, had served, apart from its own functions, to draw attention to the urgent need of the establishment of a Ministry of Commerce, which would protect and encourage both home and foreign trade. If the organisation were carried on by business men on business lines, the advantage would be incalculable.

He advocated very strongly that greater effort should be made in the direction of providing for a more prolonged general education, specially avoiding the serious error of discarding the study of all subjects which did not appear to have essential connection with the profession in view. To build high it was necessary to start with a broad as well as a deep base, and while such a method placed the student at a disadvantage in his early twenties, it should, other things being equal, enable him later to out-distance rapidly those competitors whose field of knowledge was less broad.

The complete absence of any consideration of the cost of production both in technical colleges and technical institutions, and its insufficient consideration in works except by the more highly placed officials and a special staff, were circumstances which required prompt rectification, in the interests of our national industries. An accurate appreciation of cost came one day to most men who occupied leading positions in works, but it should be ensured at a much earlier stage in the career by education and early training in business, because it was only by the man of technical and scientific attainment that the most efficient use could be made of it.

Speaking as a technical man, and with a full appreciation of the high aims and achievements of technical men, he unhesitatingly advocated that not only should our technical colleges deal in their curricula with such questions as the relation of design to cost, and of cost to production, but that all technical institutions should, subject to proper control, open their doors to the reading of papers dealing with these subjects.

Good News from Mexico.—An American Consular agent reports better conditions on the Mexican border. He says:—"The situation in the Piedras Negras Consular district is much improved; in fact, fighting has become a thing of the past. The passenger, freight and other trains of the Mexican National Railroad are operating daily to and from southern points without molestation. Many Americans and other foreigners are crossing the International Bridge daily (date of writing November 6th) *en route* to their homes in the interior with a view to again settling down to work and rebuilding their businesses. Those coming out say conditions are becoming better each day."

MULTICORE CABLES.

By "COMMERCIAL."

In the construction of multicore electric cables of one type or another, it is often desirable to employ some means of easily distinguishing core from core, or pair from pair. The most general methods are by the use of coloured cotton lappings, and coloured tapes of paper or cotton. Cotton lappings are mainly used on telephone cables, in which unvulcanised rubber, silk and cotton form the insulation. The number of cores in such cables may run into hundreds, and it would be scarcely possible to make the cores distinguishable without the use of coloured cotton, in single or "self" colours, in double, or in triple-colour combinations. In the case of "pair" cables one colour is used throughout on one core of each pair, and combinations of two or three colours on the other core. Occasionally also, in lieu of coloured tapes, cotton lapping is used on the cores of small vulcanised rubber multicores, over the grey tape. Generally, however, coloured proof tapes are used on vulcanised rubber multicores for distinguishing purposes, and usually on bitumen cables, though some makers omit tape from the cores of the latter class. If the single colours available are insufficient two are put on in parallel, each half the width of the ordinary single colour tape, thus producing a spiral striped effect.

The use of coloured papers is confined to paper insulated power cables, and dry cores; in the latter case, sometimes accompanied by a whipping of cotton. The range of colours is necessarily more restricted than in the case of cotton, and the number of combinations of colours is correspondingly less. Also where two colours are used, they are put on in succeeding layers, and not in parallel strips as in the case of cotton tapes.

In this connection it may be interesting to ascertain, when given a number of colours, how many two-or-three-colour combinations may be obtained from them. It is found that the number of cores which can be coloured with single and two-colour combinations is equal to the sum of the numbers of the colours. That is, where three colours are used, $(1 + 2 + 3)$ cores can be coloured; or where N is the number of colours used, $\frac{1}{2}$ N (N + 1) cores may be coloured by the use of N single colours, and all possible combinations of two colours obtainable therefrom. Thus, 8 colours will give 4 (8 + 1) or 36 cores, made up of 8 cores with one colour, and 28 cores with two-colour combinations.

The numbers of combinations made by the use of three colours are rather more difficult to find by formula. On working out several examples, however, it is found that they are expressed in an irregular progression of the terms: 1; 1 + (1 + 2); 1 + (1 + 2) + (1 + 2 + 3); &c., *i.e.*, for 3 colours : 1 triple.

„ 4 „ 1 + (1 + 2) triples.
„ 5 „ 1 + (1 + 2) + (1 + 2 + 3) triples.
„ 6 „ 1 + (1 + 2) + (1 + 2 + 3) + (1 + 2 + 3 + 4) triples.
„ 7 „ 1 + (1 + 2) + (1 + 2 + 3) + (1 + 2 + 3 + 4) + (1 + 2 + 3 + 4 + 5) triples.

So that with the self colours singly, and the triple combinations, in all, 3 colours will serve 4 cores, 4 colours, 8; 5 colours, 15. Tabulating the results gives the following figures:—

No. of colours.	Self colours + 2-colour combinations.	Self-colours + 3-colour combinations.	Self-colours + 2 colours + 3 colours.
2	3	—	3
3	6	4	7
4	10	8	14
5	15	15	25
6	21	26	41
7	28	42	63
8	36	64	92
9	45	93	129
10	55	130	175
11	66	176	231
12	78	232	298
13	91	299	377
14	105	378	469
15	120	470	575

In making out a list of colours and combinations, the self colours must first be placed in a definite order and numbered, and such order must be strictly adhered to in working out the combinations. All possible two or three-colour combinations of No. 1 are then found, and so on, care being taken always to work forwards and not refer to a back or earlier colour. This precaution is necessary to avoid duplication of any set of colours. Following on after the numbers allotted to the single colours the combinations should also be numbered, as this will simplify the use of the list in practice.

The table shows how large a number of cores can be made distinguishable by means of a few colours, and it can be further extended if necessary by using different shades of some of the colours.

CORROSION OF STEEL SMOKESTACKS.

By R. I. ELKIN.

The discovery that a number of steel smokestacks throughout the country are corroding at an alarming rate has aroused much interest among central-station companies, insurance interests and others. A superficial inspection of the exterior of many of these stacks indicates that they are apparently in a satisfactory condition, but when scrutinised on the inside it is found that disintegration in many cases is proceeding rapidly. Of the stacks examined a few were lined, and these were free from attack. Those without any lining whatever were, however, deteriorating in practically every case.

A steel stack will corrode on the inside and on the outside, but this fact appears to have been overlooked in many instances, for protection has been given the exterior while the interior has been ignored, although internal corrosion is by far the more serious of the two. Corrosion of the outside of a stack is due in part to the elements and in part to acids and sulphur fumes, which attack steel quite rapidly in the presence of moisture. An inexpensive way to prevent corrosion is to paint the steel with a suitable pigment. The conditions affecting a smokestack are similar to, but much more severe than, those existing round other steel work, bridges, &c., on account of the atmospheric conditions and the rather high temperatures—a combination most favourable to corrosive action. The painting should be thorough, and not less than two coats should be applied, otherwise the pinhole abrasions in the paint and uneven coating may give a covering which is not completely protecting. To obtain the benefits of painting it should be done regularly, the frequency depending upon local conditions. About every two years suffices in average cases.

It is a less simple matter to prevent corrosion in the interior of a stack, and one which will cost more than outside protection, because the hot flue gases direct from the fires must be contended against. These gases are extremely corrosive, and will cause rapid disintegration of the steel if preventive means are not taken. The corrosion is due almost wholly to the flue gases containing moisture, which condenses against the comparatively cool walls of the metal stack. The condensate thus precipitated consists largely of sulphurous acid, while there are always present the deleterious effects of carbon-dioxide gas, which attacks steel in the presence of moisture. The remedy for corrosion on the interior of a stack is to protect the metallic wall from the acids and gases by lining it with firebrick. This lining should be carefully laid, care being taken that no air gap exists between the lining and the metallic wall, otherwise the corrosion will take place as fast as, if not faster than, when no lining is used. The intervening space between metal and brick should be filled in completely by grouting with cement. The lining should go the full height of the stack, because with unlined stacks it has been found that the upper rings corrode faster than the lower, owing, no doubt, to the greater condensation at the top of the stack.

One of the things most conducive to corrosion is to take an unlined stack out of service from time to time, even for short periods. Experience, however, seems to indicate that allowing a stack which is properly lined to stand idle has little effect upon corrosion. This is a great advantage to steam plants operating in connection with hydro-electric plants where the water supply is erratic or insufficient at all periods of the year. A further advantage of lining a stack, besides that of protecting it and thereby prolonging its life, is that the radiating losses through the metallic walls are very materially reduced, thus improving the draught.—*Electrical World.*

The German Cable Makers' Syndicate.—It is reported that this syndicate, which would nominally expire with the current year, has been prolonged until April 1st, 1916. The syndicate has been provisionally extended several times since the outbreak of the war, and it is not intended definitely to renew it during the continuance of hostilities.

ELECTRICAL DEVELOPMENT IN GERMANY AFTER THE WAR.

The magnitude of the prevision which has characterised Germany's preparations in almost every direction for the conduct of the present war is to be emulated on a smaller scale during the course of this world-conflict by the exercise of foresight regarding the supply of electricity after the conclusion of peace. It is contended that electricity will then play an important part in a double sense in connection with the reorganisation of the economic conditions in that country. In the first place, it will have to be substituted for other lighting agencies and forms of power in industries and agriculture to a far greater extent than hitherto, and the larger extension of the use of electrical energy will, it is held, represent the supersession of foreign materials and an economy in the national sources of energy. The second point is that the State, according to former and recent indications, intends to utilise this source of power for national purposes, and from this standpoint Gustav Siegel discussed the subject a few months ago in the *Preussische Jahrbucher*. The opinions expressed by the author are not only of importance and interest, both from a general point of view and from that of the competitive capability of Germany in the future, but they gain increased value from the fact that the fundamental idea underlying them was approved by Dr. Emil Rathenau (now deceased), in a preface attached to a reprint of the article from the journal in question.

The development of electricity in Germany has so far been divided into three stages. The first, which extended to 1890, was that of technical and economic experiment; the second, which ended with 1900, was the period during which local works were erected and electric motors were introduced into minor industries; and the third has been characterised by the expansion of overland central stations so that lighting and electric power are becoming general in industries and agriculture. In addition to the participation of local authorities, provinces, and States in the supply of electricity from overland stations, chiefly for the purpose of supervision, the co-determination of conditions of supply and the adoption of guiding principles for dealing with distant districts, the States of Prussia, Bavaria, and Baden have included within the scope of their activity the utilisation of water powers, the erection of main transmission lines, and the operation of these works. As to the further intervention of the State, the author considers that this is necessary so as to secure wayleaves in order to be able to install networks at comparatively low cost by overriding the arbitrary demands of individuals, and also for the establishment on a grand scale of generating stations directly on the site of the production of coal, and the location of water powers and peat moors, and the interconnection of these stations on a uniform plan by the erection of a high-tension network over the whole of the empire. This, then, is the principle of the scheme, which naturally raises various questions in connection with the extent of the present and the prospective supply of electricity.

The total capacity of the generating stations engaged on furnishing electrical energy to the public is stated to have amounted to 2,000,000 KW. in 1913, and that of the private and individual installations with their own generating plant was 8,000,000 KW., whilst the total consumption for lighting and power purposes throughout Germany is estimated to have been 30,000,000,000 KW.-hours, to which has to be added a further 10,000,000,000 KW.-hours used for railway purposes. Although these figures are enormous, it is calculated that they would be doubled in the course of ten years, and that one-half of the quantity then consumed—40,000,000,000 KW.-hours—would be able to be delivered by the generating stations which serve the general public. At present the area supplied by the latter has a population of 45,000,000 persons, and it would be possible to include the remainder of the empire by the enactment of an expropriation or wayleaves law. As, however, the prospects of passing such a law are deemed to be infinitesimal, the author discusses the question of the imposition of a tax on the consumption of electricity, as has been suggested for the period after the war is over. Such a proposal is considered to have opposed to it still greater objections than were raised against the similar plan which was abandoned in 1908 in favour of a tax on illuminating appliances, which has hitherto yielded one-third less than was expected by the Government, as a high tax when peace again prevails would be fatal to industries. It would hamper the export trade and increase the cost of supply in the inland market, especially as the industrial products to a preponderating extent are not for direct consumption, but serve for the manufacture of other articles.

The question of the State expropriation of the undertakings which supply general consumers is argued to be a much less satisfactory proposal for the nation than that of the adoption of a general scheme of development of huge stations with a vast network of feeders to transformer stations in different parts of the country. As to the financial effects of the former, the author states that the gross surplus realised by all electricity works in Germany in 1913 was, approximately, £11,250,000, and after providing for depreciation at the rate of 3½ per cent., there remained net profits of £7,350,000. If this sum is capitalised at 5 per cent., the price of purchase to the State would be £147,000,000, and if the depreciation provision made by the State were reduced to 2 per cent., and the purchase price were raised by means of a 4½ per cent. loan, the surplus available to the State for free disposal would be only £1,850,000. This comparatively small sum would represent the whole proceeds of the monopoly, which would, however, by no means counterbalance the disadvantages of the monopoly. Under these circumstances, the author contends that the duty of the State should lie rather in the exercise of a regulating and promoting influence upon the supply of electricity than to paralyse capital and labour through the institution of a monopoly, and in the former instance a prominent opportunity is afforded for also securing a considerable revenue to the State.

The definite proposal made in this connection, as previously mentioned, is that it would be advantageous for the State to erect and work huge generating stations at coal mines, at suitable water powers, and adjoining extensive deposits of peat on the moors, the stations to be interconnected with each other by means of high-tension mains, from which electrical energy would be transmitted to specified transformer stations of large dimensions. This idea is essentially a development of the pit bank practice of one or two stations of the Westphalian Electricity Works in the district of Dortmund, of the present utilisation of certain lignite deposits at Bitterfeld, and of the contemplated extensive use of other lignite mines in that district indirectly for electrochemical industries; and of the existing use of certain peat moors in East Friesland. But, naturally, the inclusion of large transformer stations carries the scheme much further. It is suggested, for instance, that the limits of the State action should be fixed at the transformer stations, and the distribution then undertaken by the present owners of electricity supply works. In other words, the State would become a supplier in bulk. It is assumed that by the establishment of the generating stations at the source of power, and the installation of huge units, it would be possible for the State to deliver so cheaply that it would be of advantage to most of the existing works to procure a supply by means of the State transmission lines, whilst, conversely, the latter works would be under the obligation to afford a supply to the State in so far as the technical conditions would permit and the prices were equal to those of the State. It is calculated that an initial expenditure of £20,000,000 on the works and lines, and an estimated sale of 6,000,000,000 KW.-hours per annum, would yield a net surplus of £3,000,000 per annum, or twice as much as would be derived from a tax on the consumption of electricity under present conditions, and still more than would be obtained from a State monopoly of the supply works with over seven times the amount of capital investment; whilst a further extension of the stations and a turnover increased to 12,000,000,000 KW.-hours would raise the net revenue to £4,500,000, even if the bulk price were reduced. The approval given to the general idea by Dr. Emil Rathenau, as already referred to, was accompanied by the statement that the suggested Imperial Electricity Union would receive all the revenue, and, after indemnifying the individual Federal States for the expenditure incurred by them in associating themselves with the scheme, and securing to them a share in the profits, the balance remaining would devolve upon the Imperial Treasury for the general benefit of the country.

DOMESTIC ELECTRIC HEATING.

Lecturing at University College, London, on Friday last, Prof. A. H. Barker dealt with the application of electrical heating methods to domestic requirements. He regarded electric heating as the system of the future *par excellence*, in spite of the obstacles which at present hindered its development—chief of which was its high cost, in comparison with older methods. The requirements to be met in connection with domestic heating were extremely complex; the reading of a thermometer was utterly misleading, and there was a great divergence between the real problem and conventional ideas on the subject.

The orthodox view was that the thermometer indicated the "temperature of the room," as if the room were full of liquid; but it really indicated only its *own* temperature, the resultant of radiation and convection.

It was usual to assume that heat was conducted out through the wall at a rate proportional to the difference between the internal and external temperatures, and to the area of the walls; the ventilation requirements were based on the supposed permissible limits of the CO_2 content of the air, and it was taken that the incoming air must be heated up to 60 deg. F., whilst the external temperature was 30 deg. F. These considerations led to the conclusion that to provide for maintaining the room temperature and for heating the necessary volume of fresh air an allowance of about twice as many B.TH.U. per hour as the volume of the room in cubic feet was necessary. An ordinary hot-water radiator at a temperature of 160 deg. gave off about 140 heat units per square foot per hour. These data were the basis of the heating engineer's calculations, and on these lines, taking a concrete example, it

was estimated that about one watt per cubic foot should suffice to heat a certain apartment; but in practice it was found that two watts were required, and it was necessary to discover the fallacy.

Taking the walls to be at 30 deg. F. to commence with, on a still day, on starting the radiators the internal surface of the wall would rise in temperature and a temperature gradient would be established in the wall, which would ultimately acquire a mean temperature about half-way between the inside and outside temperatures; an immense amount of heat would be absorbed by the walls in attaining this state, and, in fact, if no heat were lost from the outside, it would take about 19 hours to warm the walls alone, with all the radiators full on, in the case under consideration.

It would clearly be out of the question to carry this out with electric heaters; their function should be to heat little-used rooms occasionally for a few hours, without attempting to heat up the walls. The question, then, arose: What were the conditions which constituted comfort? The human body was constantly parting with heat by radiation, convection, and evaporation, and in order that a man might not "feel cold," an excessive demand must not be made upon his body for heat; the chief function of the electrical heater was to reduce the call upon the body below the limit at which discomfort was felt, and for this purpose the luminous radiator was the appropriate means.

It was necessary to produce a feeling of warmth without a feeling of oppression; the purity of the air had little to do with this, in spite of the popular notions. A person had been experimentally enclosed in a cabinet until the atmosphere within it became foul and gave him a feeling of oppression and discomfort; he was then allowed to breathe the outer air through a tube, but felt no better. When, however, he was taken out of the cabinet and allowed to breathe the foul air within the cabinet by means of a tube, he felt fresh and comfortable. Evidently the cause of the oppression must be sought elsewhere than in the impurity of the air. It was, in fact, possible to warm a room and fill it with fresh pure air, and yet to experience great discomfort when occupying it. Hence it was important to discover the true conditions which gave rise to comfort and discomfort; and it was because electrical heating could be made to respond to any desired conditions that it was so valuable. The oppression due to heat was the worst factor—though one might at the same time feel cold.

Extended investigations had been carried out at University College on the subject. It was necessary to take into account the true temperature of the air apart from the effect of radiation, which is totally independent of the former, and the lecturer had devised special thermometers for ascertaining these quantities, with the result that he claimed to have proved that "stuffiness" was due largely to the fact that the air temperature was too high and the radiant temperature too low. The open fire was very popular, having a high radiant temperature without heating the air excessively, whilst it also drew in fresh *cool* air, which at the same time was at a lower absolute humidity. The intermixture of the streams of cool air entering through crevices, etc., with the warmer air in the room produced a "streakiness" which made it feel fresh; this could be artificially imitated without admitting fresh air. One feature of the open fire was that the temperature was not uniform all over the room—an advantage, not a defect. To warm the incoming air as it entered a room was an utterly mistaken plan; the coldness and dryness of the fresh air were essential qualities.

The necessary radiant heat must be supplied in the proper quantity and direction. Some would be reflected from the walls, some absorbed in the walls and by the air, some radiated through the windows; much of it was, therefore, quickly lost, and the radiators should be constructed so as to *direct* the radiant energy upon the persons in the room. Dr. Leonard Hill and the author had investigated complaints of the defective ventilation at the House of Commons, and found that immense volumes of fresh air were poured into it, yet the atmosphere produced lassitude; this feeling was found to be due to the feet of the members being cooled more than their heads, which was precisely the wrong effect to be aimed at. In the open air the contrary was the case. Hence they must make sure that a good proportion of radiant energy would be projected downwards in a room. Electric carpets were admirable heaters.

On the invitation of the General Electric Co., Ltd., he had carried out an extended series of experiments on their electric radiators, and had devised methods of separately testing the radiation and convection from them; by means of a thermopile and a device for holding the radiator in various positions he had obtained polar curves showing the distribution of the radiation in all directions. All electrical radiators had an efficiency of 100 per cent. in converting electrical into heat energy; but the proportion of radiant to total energy varied with the construction of the apparatus. The best he had found was 69.4 per cent. He had also determined the proportion of the total radiation which was directed on a zone 4 ft. high and 5 ft. from the radiator, this being the part that would fall upon a person sitting in a chair at that radius. In the course of his experiments he had ascertained that a person could feel comfortable whilst sitting still, in air at a temperature of 50 deg. F., if the radiant heat falling upon him from one side was at least 2.5 watts per sq. ft. of normal surface. When the air temperature was below 48 deg. F., he could not feel warm no matter what the radiation from one side only, but if radiant heat were supplied from both sides, a flow of 1.7 watts per sq. ft. on each side enabled him to feel comfortable in air at a temperature of 40 deg. F.

A hot coal fire in a cold room might scorch one without removing the feeling of chill, and the manufacturers of electric radiators should avoid the mistake of providing too intense a radiation.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Consular Service Again.

I am sure that most of your readers will agree with the remarks on the Consular Service in your issue of September 10th. The whole question of the part to be played by the Government in promoting British trade should be considered *now* by those most interested, viz., the manufacturers themselves. Now is the time for manufacturers to put constructive proposals before the departments concerned—the Board of Trade and the Foreign Office. As you point out, Consuls cannot be expected to do what manufacturers themselves ought to do. Our big manufacturers have their own channels for obtaining reliable information as to opportunities for trade, and as regards the supply of this, the services of the official trade scout will, to a large extent, only be in demand by the smaller firms. It will, therefore, be in the direction of giving official support to representations to foreign Governments in connection with public works, tariff difficulties, and the like, that the British official can render most useful assistance. He should, of course, also report on such opportunities for British trade as come under his notice.

The United States Government, whose reports you rightly commend, has lately made a new departure in regard to its efforts to foment foreign trade by appointing a number of commercial attachés, who are in no way controlled by the State Department, which corresponds to our Foreign Office, but are under the direction of the Department of Commerce, which corresponds to our Board of Trade. In other words, the American Government has applied to foreign countries our practice as regards the self-governing Dominions, where the Trade Commissioners are appointed by the Board of Trade. The American Government has, apparently, recognised that its representation in commercial matters needed strengthening, not only as regards the number of its representatives, but also that the official whose duty it is to study trade matters should not have his attention diverted by the hundred-and-one things a Consul has to do. The British Commercial Attachés appointed by the Foreign Office at present are eight in number, confining their attention to the principal European countries, China, and Japan. Outside of our Consuls, we have no officers expressly charged with the duty of investigating trade matters in the United States or in the growing markets of Latin America, where such an immense amount of British capital is invested, and where our imports represent a vast sum. It certainly seems somewhat of an anomaly that while Commissioners of the Board of Trade have been appointed to the self-governing Dominions where racial sentiment and tariff preferences all favour the British manufacturer, the presumably less effective representation by Consuls has been considered sufficient in important foreign markets, where the British manufacturer has neither the tariff preference nor the sentiment mentioned to assist him. If Mr. E. W. Stevenson, of Brooklyn, who writes in your issue of September 10th, will consult official figures, he will see that instead of our Colonies taking, as he supposes, about 75 per cent. of our foreign exports, they took about 37 per cent. of these in 1913. In other words, nearly two-thirds of our export trade is outside the Empire. Now, while we are all anxious to see increased trade within the Empire, we cannot afford to neglect that with foreign countries, and just in proportion as this latter is the more difficult to hold, so it ought to be supported and fomented by the Foreign Office and the Board of Trade if, as I believe, official efforts to promote trade are of real use to manufacturers.

I hope the Chambers of Commerce and such like bodies will get busy and press the matter of reform in trade representation on the Government without waiting for the end of the war.

Viator.

Melbourne, *November 1st*, 1915.

More News from Ruhleben.

It has occurred to us that a short report of the lot of engineers interned here at Ruhleben will be interesting and acceptable to our colleagues at home. We have, therefore, pleasure in addressing you the following notes relative to the activities of engineers here, and to the conditions under which their labours are being carried on.

As may well be imagined, there are a large number of engineers in the camp, and all branches of engineering are

represented. The majority were either employed in Germany prior to August 4th, 1914, or were engineers on ships which were moored in German ports on that date; the remainder were either detained in Germany when travelling through home from other countries (chiefly those of the Near East), or were on holiday here when war was declared.

During the first few months of our internment, the engineers were completely inactive. The mental depression incidental to exile, the inconveniences incidental to internment, and the vain, but importunate, hope that liberty was nigh, prevented utterly all serious work and study. Gradually, however, it was realised that a long internment was inevitable, and so, with traditional national adaptability, we set to work. A movement was set afoot to ascertain the number and needs of engineers in the camp. It was found that besides the large number of marine engineers, who had already formed an excellent local branch of the M.E.A., there were about 60 other engineers. To enable the latter to get an opportunity of interchanging ideas, an engineering society, called "The Technical Circle," was formed. A chairman, secretary, and committee were appointed, and weekly meetings were arranged, the general procedure at the meetings being similar to that adopted by our Engineering Institutions at home.

The first meeting of "The Technical Circle" was held on August 5th, 1915. [Some particulars of the proceedings of this Circle appeared in a letter from another correspondent published in the Electrical Review for November 19th, p. 657.—Eds. E.R.]

In addition to these activities, practically every engineer here is taking advantage of the opportunity of learning European languages. Ruhleben Camp, although officially an English camp, is really very cosmopolitan. Several men may be found here who have lived many years in any European country that one chooses to think of, and the majority of these willingly give instruction in languages in which they are proficient. As a large number of these men are engineers, the value to us of instruction from them is obvious. Our studies, however, are by no means limited to languages.

A valuable feature of technical intercourse here is the fact that we have amongst our circle members, men who, as already indicated, are acquainted with the engineering conditions in all parts of the world. The importance of that cannot be exaggerated, as it offers a source of reliable information as to the engineering possibilities of existing and future markets; an engineer destined for the development of future foreign markets, in fact, can do much here to extend his knowledge. Incidentally, the number of engineers interned here and the diversity of their activities is proof of the ubiquity of the British engineer.

These few notes will, we hope, be of interest to our colleagues at home. When considering our aforementioned activities, the disadvantageous conditions under which we labour should be borne in mind. The prolonged internment and the continuous isolation from all external society have proved a serious handicap. A great disability is gradually being removed by the inauguration of a scientific and literary reference library, for which we receive from time to time generous gifts from individuals and societies at home. Finally, we have had to contend all along with the galling thought of not being able to do anything for the Motherland in the hour of need. This is the most distressing feature of our captivity.

We gladly take this opportunity of wishing our colleagues at home as happy a Christmas and as prosperous a New Year as the gravity of the times will allow.

Wm. Eric Swale,
Hon. Sec. to the Committee of
"The Technical Circle."

Ruhleben, Berlin, *December 4th*, 1915.

Decimal Coinage and the Metric System.

Your very interesting articles on the decimal system suggest the question, why has the metric system not made more progress? Probably one reason is that schoolmasters have been in the habit of getting pupils to do puzzling problems in the conversion of the metric system to the British and *vice versa*, and the pupils have got the idea that if the metric system were introduced it would be necessary to spend their time in converting kilograms to pounds and metres to feet and inches. After such a course of instruction, most pupils leave school with an aversion to the decimal system which no argument can shake.

The following examination paper, with answers, may serve to show how an intelligent pupil might be permitted to answer the examiner's posers. If answers like these procured the passing of the examination, we might expect the metric system to make rapid progress in the near future:—

Question 1.—A lady desires to buy a yard and a-half of tape. What will she ask for in the metric system, given one yard equal .9144 m.?

Answer.—She would ask for a metre and a-half.

Question 2.—A surveyor measures a piece of land and finds that it contains 4 acres 2 roods 10 perches. How will he express it in the metric system?

Answer.—He would measure it in the metric system, and so would not require conversion. Where it was necessary to do conversions like this the work would be carried out by tables.

Question 3.—A loaf of bread weighs 4 lb. 4 oz. 3 dr. What will be its weight in the metric system, given 1 oz. equal 28.34954 grams?

Answer.—The loaf will weigh about 2 kilograms.

Question 4.—A man desires a gill of lemonade. What would he ask for in the metric system, given that one pint equals .02005 cubic foot and one cubic inch equals .00001638 cubic metres?

Answer.—He would ask for a glass of lemonade, and if that did not satisfy him he would have another.

C. Turnbull.

Tynemouth Electricity Works,
December 6th, 1915.

I have read with interest some of your articles on the metric system and on decimal coinage. Though a Frenchman, I have had a good deal to do with the English systems, because I have been connected for quite a long time with English and American firms. I remember I had to check several estimates where a certain amount of metres of cable was quoted at so much £ s. d. per mile. It was no joke, and I have often thought that it would not be impossible for the English Government to adopt, at least, the decimal coinage. In fact, so far as pounds sterling and shillings, and down to the sixpence coin are concerned, the present system is almost decimal; after the sixpence coin it is not.

Let us assume, now, that the Government should decide to do away with the copper coins and to replace them by nickel coins; it would be possible to divide the shilling into 100 cents and to adopt nickel coins of, say, 25, 10, and 5 cents, similar to those used in Belgium and to those which will be used in France after the war.

The following table shows the corresponding values of cents and pence, the pence being expressed in decimal values:—

Cents.	Pence.	Cents.	Pence.	Cents.	Pence.	Cents.	Pence.
5	.6	30	3.6	55	6.6	80	9.6
10	1.2	35	4.2	60	7.2	85	10.2
15	1.8	40	4.8	65	7.8	90	10.8
20	2.4	45	5.4	70	8.4	95	11.4
25	3	50	6	75	9	100	12

Let us suppose that the English Government made compulsory the quoting of all merchandise in shillings and cents instead of £ s. d. For the period of transition during which the copper pennies and halfpennies would be collected away, it would perhaps be necessary to mark on labels both quotations, say, for instance, 44.95s. = £2 4s. 11.4d.

On the table it can be seen that the decimals of the pennies corresponding to 5, 10, 15, etc., cents are always .6, .2, .8, .4. In order to make the exact change, it would be necessary to make two small copper coins, one of .1 of a penny and the other of .3 of a penny, which, by the way, could be marked as 2.5 cents, because with the halfpenny being equal to .5 of a penny, all the decimals of a penny shown on the table can be made: .2 = 2 coins of .1d.; .4 = 1 coin of .3d. + 1 coin of .1d., or 1 halfpenny—1 coin of .1d.; .6 = 2 coins of .3d.; .8 = 1 halfpenny + 1 coin of .3d.; other combinations are also possible.

When all the copper pennies were withdrawn from circulation, it would also be possible to withdraw the .1d. coin, which is necessary only for the period of transition; but the .3d., or 2.5 cents, could be kept as useful to quote merchandise or small value, for instance, an article sold at, say, .175 cent the lb. (* See note.)

I advocate the above decimalising of the money because English money is used only in England, and does not circulate in other countries; but I would never suggest to decimalise the English system of weights and measures, because the metric system is the only one which is easy, logical, and of almost universal use, and its adoption would help the English people and foreigners to understand each other better on all English exportation business.

* Note.—The making of .1d. and .3d. coins is necessary if the change must be exact. In order to avoid this double creation, another solution could be considered.

It could be decided that the farthing should be equal to .2d., instead of .25d., as at present; it can be seen from the table that it will then be possible to exchange any amount of cents for copper pence, halfpence, and farthings without making new copper coins.

This, of course, would be detrimental to the holder of farthings; but it could also be decided that, after the withdrawal of all pennies and halfpennies, the value of the farthing should be 2.5 cents, which would be a compensation.

The inconvenience of this scheme would be that the holders of farthings would keep them during the transition period in order to make a profit afterwards. That is why it will be necessary to make .25 cents new copper coins, to avoid the rarity of small coins during that period.

H. Planchon.

France, *December 4th*, 1915.

[We are very much indebted to our correspondent for his interesting letter, which explains an ingenious method of effecting the change from pence to cents. We refer to the matter in our leading columns to-day.—Eds. Elec. Rev.]

The Institution and Alien Enemy Members.

The letters regarding the above matter appearing in this valuable journal, by "Station Engineer" and "Another Station Engineer," should act as a stimulus to those members of our Institution who, apparently, do not appreciate the situation. One has only to refer to page 64 of No. 251, Vol. 54, of the *Journal*, and surely the names of those members emblazoned on the roll of honour should stir their hearts to some action. The *Journal* is read, I take it, by alien members, and it seems an insult to the memory of those members who have given their lives to be recorded in the *Journal* under such conditions.

Surely the Council realise the facts; why have they not moved in the matter long ago? One observes several military members amongst eminent men whose names are recorded on the opening pages of the "list of officers and members"; cannot they do anything to stir the life-blood of the Council to some action?

It is unnecessary to quote the feeling of members on active service in war areas, but they can be realised; and it is quite time action in some direction was taken. Cannot this question be thoroughly ventilated at the next meeting, please?

A.M.I.E.E.

B.E.F., France.

Finchley Breakdown.

In connection with your report, in last week's publication, of the interruption to the electricity supply of the Finchley Council, I beg to draw your attention to the fact that your statement of the supply being interrupted "till 8 a.m. Monday morning" is not quite complete.

The particular section from which the writer receives his supply was still interrupted on the Wednesday following, and no definite statement was then obtainable as to when supply would be resumed. As a matter of fact, the supply was resumed at 9 p.m. on the Wednesday following the breakdown of Sunday, but, in view of the great inconvenience caused to consumers, it seems desirable that some official statement should be forthcoming as to the cause of breakdown, with the object of avoiding its repetition. The average person is under the impression that modern electricity supply is reasonably reliable, assuming good design and maintenance, but this does not seem to obtain in the present case.

Consumer.

The A.E.G. Meeting.

In response to the courteous invitation of the Secretary of the Electrical Contractors' Association, I waited on him at his office. As he is a personal friend of long standing, I did not find it difficult to convince him of my *bona-fides* or the point of view from which my remarks should be taken.

As there does not now appear to be any difference of opinion as to the main question of dealing with, or buying goods from, firms of questionable standing from the enemy standpoint, the whole matter resolves itself into a very narrow compass.

The E.C.A. offers to circularise its members, and claims that by the result it would be able to refute one of my charges. Now this is entirely unnecessary, and would serve no useful or other purpose. From a list of its members I was able to see that at least 75 per cent. are well known to me. Many are old personal friends, and I do not doubt, nor have I ever doubted, that 100 per cent. of the members would give a satisfactory reply to such a question. But for a body of 10 per cent. of men, however high-standing, to claim to speak for the whole of a particular trade or industry is fatuous presumption. I have the highest respect and regard for the members of the E.C.A. as such, but it does not blind me to the obvious. I repeat that there are as nearly as possible 5,000 men or firms who do electrical contracting work in the United Kingdom. Some may do it as a separate or entire business, whilst others do it in combination with another business. But all of these are electrical contractors, and until the E.C.A. can stop these others from doing this electrical work, they will class themselves and be classed as electrical contractors.

There are quite simple means of tackling the matter in a satisfactory manner, such as would at the same time put an end to the scandal I have written you on, and some others which I could also mention, and if, as I hope and believe, the E.C.A. and the B.E.A.M.A. will put their heads together in an intelligent and trustful way, they will soon find the solution.

I admit that, even after the means are found, the task is not an easy one, and will need tact and patience, but if the general body of the E.C.A. possess these qualities to the same extent as their worthy Secretary, I have no fear of the ultimate success.

Mr. Tate will, I believe, be able to report to his Committee that my experience not only has *not* been gained amongst the "cheap and nasty" type, but, strange to say, amongst the general body of the members of the E.C.A.

Some of your correspondents have adopted the tone of "Mind your own business," or "Don't cry stinking fish." My own view is that a person who, having certain knowledge, keeps it to himself is acting selfishly to his confrères.

For some years previous to this present state, I had been warning my friends as to what, in my opinion, was coming. I was laughed at or jeered at, and many of my friends dubbed me "German mad." I am sorry to see I was right.

During the last ten years I have travelled all over the European Continent. I am well acquainted, from actual experience, with the business methods and habits of all of the countries. Without exception, the general opinion in those countries is that, during the last few years, the electrical industry in this country and her Colonies has been in the hands of the Germans, or under their influence. One does not hear opinions voiced in such widely different parts or by men of such divergent lines of thought without being deeply affected, that is, of course, if one is possessed of any love of country, people, or profession. In the last few remarks, dear Mr. Editor, I disclose to you the reasons which have impelled me to write you. I sincerely trust that in a few years I shall be able to think I was as wrong in my fears on this subject as I was right as to this present war.

I thank you for the patience with which you have borne with me, and in future I will devote my surplus energies on this subject to worrying or, perhaps, assisting the worthy Secretary of the E.C.A.

If I required any self-advertisement I should not still sign myself

Anti-Humbug.

December 9th, 1915.

With reference to the correspondence that has appeared in your journal, I wish to complete my previous letter by informing you that I have met the writer of the letters signed "Anti-Humbug," and was pleased to find that he is a gentleman extremely well known in the trade, and one who has been a personal friend of mine for over 20 years. During our conversation we found that our aims were identical, and I am pleased to say that he entirely approved of the methods under which my Executive had acted with regard to the matters under discussion. I am also pleased to state that he fully convinced me of his reasons for not at the present moment disclosing his personality, and I can only state that, should he desire to do so, the whole of the British portion of the electrical industry would agree that his position is such that his opinions would be worthy of their best consideration.

Leonard G. Tate, *Secretary,*
Electrical Contractors' Association.

London, E.C., *December 13th*, 1915.

WAR ITEMS.

Trading with the Enemy.—A Reuter dispatch from Cape Town states that the Trading with the Enemy Bill, which has now been published there, imposes seven years' imprisonment, with or without a fine, for offences committed since the beginning of the war, and provides for the inspection of the books of enemy firms. Dividends accruing to the enemy are to be paid to the Treasury, which may appoint a receiver to control any business undertaking. Enemy property and holdings of shares have to be notified to the authorities.

A Reuter dispatch from Melbourne says that a proclamation has been gazetted tightening up the provisions excluding enemy goods from Australia, both by direct and indirect importation. It is stated that drastic action is contemplated.

On December 8th, in the House of Commons, replying to a question of Sir J. Lonsdale, the Attorney-General said he thought that the decision in the Continental Tyre case, whether technically correct or not, left the law in an unsatisfactory condition. The case was being carried to the House of Lords, and a decision on the matter there would settle whether further legislation was necessary.

In the House of Commons, on December 10th, Lord Robert Cecil introduced the Trading with the Enemy (Extension) Bill, which (according to the "Financial Times") provides that His Majesty may by Proclamation prohibit all persons resident, carrying on business, or being, in the United Kingdom, from trading with any persons or bodies of persons resident or carrying on business in enemy territory, or in territory in the occupation of the enemy, wherever, by reason of the enemy nationality or enemy association of such persons or bodies of persons, it appears to His Majesty expedient so to do, and if any person acts in contravention of any such Proclamation, he shall be guilty of a misdemeanour, triable and punishable in like manner as the offence of trading with the enemy. For the purposes of the Act, a person shall be deemed to have traded with a person or body of persons to whom a Proclamation issued under the Act applies if he enters into any transaction or does any act with, to, on behalf of, or for the benefit of, such a person or body of persons, which, if entered into or done with, to, on behalf of, or for the benefit of, an enemy, would be trading with the enemy.

In the House of Lords, on 9th inst., Lord Halsbury moved the second reading of the Companies of Enemy Character Bill. This Bill provides that where it shall appear to the Attorney-General that any company registered in the United Kingdom is, owing to the character of its directors

or of its shareholders, or to any other cause, of a predominantly enemy character, he shall present a petition praying that such company be declared of enemy character. His lordship said that he had introduced the Bill to check what he believed to be a gross abuse of the law, assuming the decision of the Court of Appeal in the Continental Tyre case to represent the law. He had received an extraordinary number of requests to proceed with the Bill, and undoubtedly the matter was one of great national importance. The Judicial Committee of the Privy Council should decide whether a company was of a predominantly enemy character. The Lord Chancellor, in reply, referred to the Continental Tyre case which had been the subject of consideration for upwards of twelve months, and no step had been taken until recently to bring it before the House. He agreed with Lord Halsbury that there was no reason why he should postpone any longer bringing forward a Bill to deal with that decision as it stood, but the case would now be brought before the House and every opportunity would be given for the hearing to be expedited. It was desirable to settle the law by the highest authority before any attempt was made to alter it, and in such circumstances it would be impossible for the Government to undertake to proceed with the Bill or to give it facilities in another place, but he saw no reason why it should not be read a second time. Under the present law the collection of outstanding debts by these companies was not prevented. They had the protection of the Courts, and could recover their debts, but having recovered them they could not dispose of them to any enemy alien, so that the danger they had to guard against was not imminent or grave. The position was, however, startling and undesirable, and he saw no reason why it should not be altered. Though he had no desire to oppose the second reading, and though the principle was one to which general assent might readily be accorded, he feared that there was little prospect of it becoming law, and possibly, in the circumstances, Lord Halsbury might not desire to go beyond the second reading. Lord Halsbury wished the Bill to go forward to Committee, and it was read a second time.

In the House of Commons on Monday, December 13th, Lord R. Cecil moved the second reading of the Trading with the Enemy (Extension) Bill. Lord Cecil said that the object of the Bill was to impede, if not to stop, enemy trading in neutral countries. As the law now stood it was not an offence for a British subject to treat with a German firm in a neutral country, nor was it an offence for ships to carry his goods, or for banks to manage his business. In some neutral countries, particularly in South America, German firms were doing a good trade and directly assisting the enemy, and even now, though we had swept the seas of German ships, the money which the Germans had amassed was being used to assist the belligerent purposes of the enemy. Lord Cecil said that the intricacies of modern trade were so great that we had to be extremely careful lest a blow aimed at German trade should react on British trade. The French plan was to say that birth should be the only guide as to the belligerent character of a person or firm in neutral countries, but it was doubtful whether that would be effective in the present case. A German firm could employ a neutral firm or person as its agent in a neutral country. There were some districts, however, where trade was so entirely in German hands that to cut off their trade would be to cripple British trade there. In the view of the Government the best results would ensue if they formed a black list of traders in neutral countries who were substantially enemy firms who could be cut off from British intercourse without interfering seriously with British trade. They must bear in mind the enormous importance of preserving British export. Under the Bill, which he regarded as one likely to diminish the resources of the enemy, and one which was urgently required, it was provided for the publication by Proclamation of the names of firms with which British firms ought not to deal, and the list would be added to from time to time on the advice of the people in the district and of those who understood the trade of this country. After some discussion, the Bill was read a second time. The Solicitor-General said that the Bill had been so framed that it would apply to firms in this country, but he was not sure that that was the best way of dealing with this important subject—he hoped we should find something better than that. This was not the only specific of the Government for dealing with enemy firms in this country.

After the War Problems.—In the House of Commons, on Monday, Sir E. Cornwall asked the Prime Minister whether he would appoint two or three committees of the House to consider and report on the problems which would arise after the war, more especially affecting the re-instatement of the men who had given up their positions and prospects to enlist, trade within the Empire, and trade development generally by this country and our Allies. Mr. Asquith, in reply, said that the Government were fully alive to the great importance of the economic, social, commercial, and financial problems that would arise after the war, and he was strongly of opinion that not even our preoccupation with the immediate and paramount task of ensuring victory ought to prevent us from taking measures to ensure that these problems should be carefully explored by skilled experts in advance. A great deal of preparatory investigation was already taking place, but much of it was naturally unsuited for public discussion at present. He doubted if the precise machinery suggested in the question was best suited for the purpose.

One of the most important debates that has yet taken place on after the war problems was that which was opened in the House of Lords on Tuesday by Lord Parker. The Marquess of Crewe replied showing what the Government views were, and other speakers were Lord Haldane, Lord Lansdowne, and Lord Bryce. The speeches show that our leaders and some of the existing Government Departments are fully alive to the seriousness of the questions involved, and that early action is needed. We shall refer to the matter in our next issue.

Enemy Businesses in Russia.—H.M. Commercial Attaché at Petrograd (Mr. H. Cooke) has transmitted a list of enemy companies or firms in Russia which are under compulsory liquidation in accordance with the Laws of 11th/24th January and 10th/23rd May, 1915. The former Law refers, in this connection, to commercial undertakings belonging to subjects of enemy countries, or partnerships to which enemy subjects belong, or branches of enemy companies, authorised to carry on operations in Russia. The supplementary Law of 10th/23rd May excluded from the operation of these enactments companies, etc., in which enemy subjects participated as partners, if the latter left the concern before 1st/14th April, 1915. The list of enemy companies, etc., which also contains the dates of the separate official notifications concerning claims and the address of the Board of Liquidation appointed in respect of each concern, may be consulted by British firms interested at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C. H.M. Commercial Attaché has also forwarded the names of certain enemy companies, etc., from whom authorisations to carry on operations in Russia have been withdrawn, and these names may be obtained on application to the Commercial Intelligence Branch at the above address.

Artificial Limbs for German Workers.—We have already referred to the various steps that are being taken in Germany in order to fit men injured in the war for industrial work when the great struggle of nations is over. The latest announcement in this connection is that the German Workers' Welfare Association, of Charlottenburg, Berlin, is organising an exhibition of specially-designed artificial limbs and body attachments that will enable men, although they may have lost a limb in the war, to follow their old employment in the engineering shop, the cotton mill, or as the case may be.

Recruiting Notes.—The whole of the eligibles on the staff of the Minehead Electric Supply Co., Ltd., including Mr. F. Swarbrick, the engineer and manager, have enlisted under Lord Derby's scheme.

No fewer than 24 members of the Torquay Corporation electrical staff have joined the Forces, and as only five eligible men are left, two of whom spend their spare time on munition work, the T.C. has decided to represent to the Recruiting Appeal Committee that the five men in question are indispensable for the carrying on of the undertaking.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New CO_2 Moore Vacuum-Tube Lamp.

At a joint meeting of the American Electrochemical Society and the Illuminating Engineering Society, held at New York on November 11th, Mr. D. McF. Moore demonstrated his new carbon-dioxide vacuum-tube lamp, which employs a new principle for automatically replenishing the supply of gas within the tube as this gas is used up during the operation of the lamp.

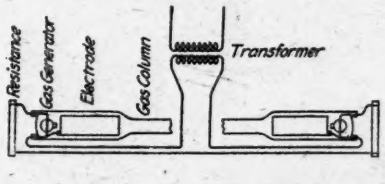


Fig. 1.—Diagram of Circuits.

This new straight-tube lamp is contained in an elongated sheet-metal case, which is provided with a screw base similar to that used on the larger sizes of incandescent lamps. Instead of the lamp being fed with CO_2 gas by means of an auto-magnetic feed valve, the gas is generated automatically within the tube itself. Near each electrode is placed a small bulb about an inch long, containing calcium carbonate, from which emanates the carbon-dioxide, CO_2, when the resistance wires embedded in it become heated to the proper degree by reason of their being connected in shunt to the gas column, as shown in the accompanying circuit

diagram. The gas column measures ¾ in. in diameter and 1 ft. in length, and appears as a solid bar of light with an appearance of intense whiteness.

The foot-candles available near the tube total more than 200, making the apparatus suitable for the very closest colour discriminations. The degree of vacuum is automatically held within 0·001 mm. of mercury column, and the apparatus will stand wide line-voltage fluctuations without becoming disarranged in any way.

This new lamp has been found suitable for making absolutely correct colour determination, and, while it is applicable to a very wide field, it is particularly useful in enabling the dye shops of the great textile industry to run night shifts.

The Couch Autophone System.

An interesting development of automatic telephony has been brought to our notice by the Private Telephone and Electrical Co., Ltd., of 28, Great Queen Street, Kingsway, W.C., which has secured the rights for this country of the Couch Autophone system. This is an automatic telephone exchange suitable for a maximum of 100 stations, and is intended to take the place of the usual manually operated private exchange. It embodies certain features of the larger automatic telephone systems, such as the dial calling device manipulated by the user, a switchboard equipped with automatic line selectors, automatic ringing and engaged signals, &c., and the central battery, but aims to reduce the installation to its simplest terms. Thus a separate selector is provided for each line, which by one operation finds the desired line and puts the caller through, or warns him that the line is busy. Fig. 2 shows the selector with its 100 line contacts, as well as three additional points for special purposes; fig. 4 shows it without the contact ring, which is easily wired, and remains fixed in the switchboard, whilst the mechanism can be readily removed and replaced; and fig. 3 is a view from the other side, showing the relays, step-by-step pawl and ratchet mechanism, &c. The switchboards are standardised for 15, 30, 50 and 100 lines, but any less number can be supplied, and selectors can afterwards be added as desired until the full capacity of the board is reached. The selectors are mounted on vertical racks in a neat dust-proof cabinet, which also contains the battery, &c. Each station is connected to the board by three wires, and the instruments are made in desk and wall patterns; fig. 5 shows the desk type, fig. 6 the wall type, and fig. 7 the latter with the dial opened showing the simple internal mechanism.

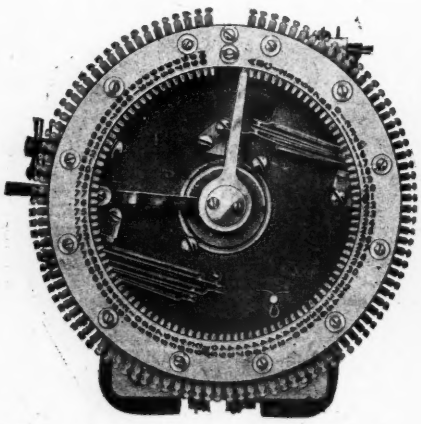


Fig. 2.—Couch Automatic Line Selector, complete

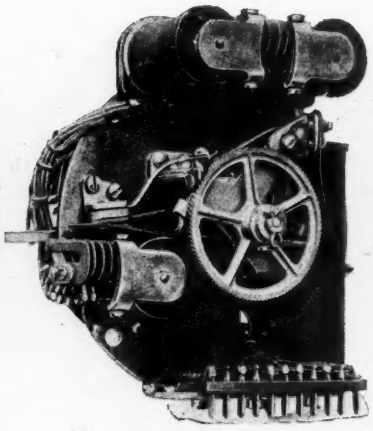


Fig. 3.—Ratchet Mechanism of Selector.

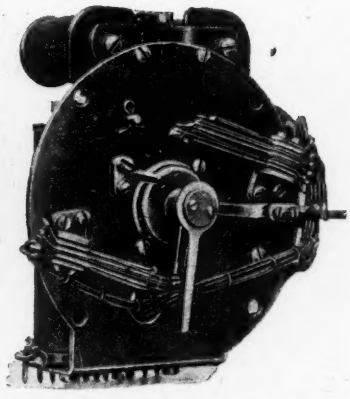
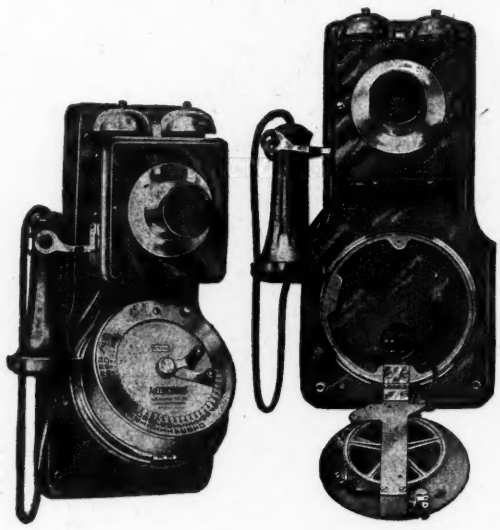


Fig. 4.—Selector removed from Wired Contact Ring

Fig. 5.—Desk Pattern of Telephone.

As compared with the manual exchange, the Couch system possesses the advantage of perfect secrecy; the moment a connection is put through, the circuit is detached from the system, and no third party can call either of the two stations concerned. There is, of course, no operator to "listen in," and no other person can overhear or interrupt the conversation. On the other hand, the person who has been called can call a third party, who will then be in direct communication with both stations, the third can call a fourth, and so on; thus a conference can be held between heads of departments, or other persons to any desired number. Another advantage is that the service is available not only during the usual working hours, but throughout the 24 hours of the day. One of the special points can be utilised to send a "general call," which is effected by means of bells situated in all the workshops, offices, &c., the ringing of which demands the attendance of the nearest official or other person at the adjoining telephone; by this means the manager for instance, whilst on a tour of the shops, can always be located and informed of urgent matters requiring his immediate attention.



Figs. 6 and 7.—Wall Pattern, Closed and Open.

The cost of the installation is necessarily greater than that of a manual exchange, but on the other hand the services of an attendant are dispensed with, secrecy is secured, a 24-hours' service is given, and there is no delay in effecting a connection; moreover there is no limit to the number of persons who may simultaneously use the system, save the full number of stations connected, and in this respect the system is superior to the ordinary automatic exchanges. The working parts being interchangeable and the operations simple, maintenance costs little and can be effected by any telephone electrician without special knowledge; the system is not experimental, having been in use in the United States for some years. We have had an opportunity of inspecting the system, and found its working all that could be desired for an intercommunication system.

Half-Watt Lanterns.

Messrs. Townshends, Ltd., of Ernest Street, Holloway Head, Birmingham, have recently introduced a number of new patterns of outdoor and indoor fittings suitable for use with half-watt

lamps, of which we illustrate a couple. The reflectors are made in extensive, intensive, and focusing shapes, and the fittings are

Fig. 8.—Townshend Open-Type Fitting.

Fig. 9.—Enclosed-Type Fitting.

hard stove enamelled on steel or copper. Fig. 8 shows an open intensive type, and fig. 9 a type with the lamp enclosed.

LEGAL.

Tramway Accident Claims.

A settlement has been effected in the Court of Session, Edinburgh, in an action in which the wife of a Glasgow engineer sued the Corporation of Glasgow for £500 damages in respect of personal injuries received on a tramcar. Payment of £100 and expenses has been made to the pursuer.

An action by a Greenock riveter, who claimed £300 damages for injuries to his child, from the Greenock and Port Glasgow Tramways Co., has also been settled, the pursuer receiving £30 and expenses.

The Mayor, &c., of West Ham, *v.* Hart Accumulator Co., Ltd.

In the King's Bench Division on December 9th, Mr. Justice Bailhache, sitting to take cases in the special paper, had this matter before him.

Mr. Williamson said that he appeared for the respondents, and he understood that certain terms had been agreed between the parties. The matter was one between the company and the West Ham Corporation with reference to terminals, and there had been an arbitration. He now asked his Lordship to allow the appeal with costs, and set aside the award that had been made on the terms agreed between the parties.

His Lordship said he was willing to do this if there was general agreement, but he could not very well set aside an award without knowing what it was.

Mr. Stephen Lynch, on behalf of the Corporation, said that by the new arrangement that had been made there would be no object in arguing the appeal against the arbitration award. The matter was very complicated, involving intricate points of law. A new agreement had now been arrived at. The appeal was set down a year ago, and it would be purely academic if argued now, and it would be a very long case. He asked the Court to allow the award to be set aside by consent. There had been a good deal of evidence submitted at the arbitration which was objected to.

His Lordship, by consent, set the award aside, without costs.

British Electric Traction Co., Ltd.

(*Concluded from page* 748.)

Mr Justice Astbury in the Chancery Division, on December 8th, decided the question which arose on a scheme of arrangement, including a reduction of capital.

His Lordship said no option was given to the holders of income certificates to receive cash or shares, the scheme involving a compulsory exchange of certificates for shares. Upon the question whether there was a real reserve fund, it appeared that the company had transferred sums amounting to £818,000 representing premiums received on shares and debentures, discount on cancelled stock, and sums transferred out of assets. Of this fund the company had written off ascertained losses on investments amounting to £336 552, and it was proposed to allocate another £124,000 towards estimated loss on capital ascertained to have taken place. There thus remained to the credit of the account the sum of £482,162. He was satisfied that this reserve fund had never been written off against investments, or the whole of it permanently applied to cover realised or estimated loss, and there was a non-capitalised fund in the company's books to that amount; but the stock market had estimated the loss at a much higher figure than ascertained by the directors because of the marked depreciation in the company's stocks. They all knew that there were many reasons to cause fluctuations on the Stock Exchange. Having gone into the evidence he was unable to come to the conclusion that the available reserve, which unquestionably had been built up out of profits, had so depreciated that the sum of £93,000 was not now available. It was a domestic matter for the directors, acting fairly and honestly by the company and having regard to its commercial interests, to allocate £93,000 of that reserve towards the capital depreciation account. The scheme, if sanctioned, would be binding on the company because the Court came to the conclusion that there was a reserve fund and that the shares would be fully paid up. He therefore sanctioned the scheme.

Upon the application of Mr. Clauson he granted the opponents of the scheme their costs.

Electrolytic Zinc for Government Supply.

A process for the production of pure zinc by electricity to meet the spelter difficulty was discussed in the Patent Courts on the 10th inst., when the Refractory Zinc Ore Treatment Co., of Devonshire Chambers, Bishopsgate, London, and New York, applied for a licence to use Patent No. 605 of 1909, belonging to Messrs. Siemens Bros., of Berlin, for a process for making anodes of massive manganese peroxide to be used in saline solutions with electricity for securing a pure form of zinc.

The application was heard by the Controller of Patents, Mr. Temple Franks, and the Deputy Controller, Sir Cornelius Dalton.

It has been found that crystalline manganese peroxide conducts the current well, and possesses the great advantage that any reduction which occurs entails only the passage of manganese ions into the solution, and these have no injurious effect on the deposition of the metal at the cathode. Under the patent, crystalline manganese peroxide, obtainable by heating manganese nitrate, is capable of being secured in massive form as a cake, and this in electrolysis is oxidised to higher stages of oxidation only very inconsiderably.

Mr. Edward Evans, for the applicants, explained that zinc ore was difficult to handle, and the applicants had in view the promotion of an undertaking (for which they would require this patent) for obtaining pure zinc by passing an electric current through a solution containing zinc ore in solution. With zinc in such urgent demand as at present, for Government and other purposes, there were considerable commercial possibilities before the scheme. It was not so long since that the Zink Gesellschaft, a powerful syndicate, cornered the ore supply in America. The price of zinc had risen since the war began from, roughly, £20 a ton to £100, and with its reduced supply, in a commercial form, owing to the lack of imports from Germany and Belgium, it was in greater demand than ever to-day for cartridge cases, shells, &c. The President of the Board of Trade and the Colonial Secretary had appointed a Special Committee to arrange an immediate scheme which should guarantee a continuous British supply, and the applicants were ready to place the results of their experiments at the disposal of that Committee. They had made experiments, in association with Messrs. Siemens, for the production of zinc by electrolysis. This electric method would be of great assistance in meeting the spelter difficulty.

Evidence was given by the applicants' technical director, Dr. P. C. C. Isherwood, chief chemist to Messrs. W. J. Bush and Co. manufacturing chemists, Hackney, who stated that Germany had made half a million tons of zinc annually from ore imported from Australia. Applicants were ready to pay 5 per cent. on the anodes manufactured. They preferred to pay the royalty in that form rather than on the zinc recovery. An anode might last a twelvemonth, and 20,000 would be required for a fairly large electrolytic installation.

Mr. Burton, for the opponents, insisted that as an anode might vary in size from a rod as small as a lead pencil to a plate as big as a blackboard, that was not the fair way of estimating royalty. The royalty should be upon the output—on what the patented process enabled them to obtain.

Dr Isherwood said the firm proposed to begin with a unit yielding 10 tons a day. As the need arose they could increase the units. They were entitled to have taken into account the experimental work they had conducted in order to apply the process to zinc. Messrs. Siemens recognised its value, and had offered to make them an equivalent reward. An anode cost, perhaps, 8s. or

9s., and if the royalty was to appear as a permanent and substantial tax on the undertaking, it would jeopardise at the outset the promotion of the company. It would be necessary to have a separate factory for making anodes, possibly under a subsidiary company. The initial step was to secure the Board of Trade's licence. Other lincenses had yet to be asked for—2,767 of 1915, and 15,128 of 1911. One of the patents taken out was the result of witness's own experiments. They received some time ago a licence from Messrs. Siemens for experimental purposes, and conducted these experiments at works at Mitcham, in Surrey. That investigation was done on an undertaking that they should supply the results to Messrs. Siemens, and with that condition they had complied. That arrangement with Messrs. Siemens came to an end before the war.

The Controller asked whether there was any obstacle in the freights from Australia, whence the ore must come.

Dr. Isherwood replied that with the ore at £80 a ton the freights were not prohibitive, and Germany had, of course, imported from Australia. Every ounce of zinc made in England came from imported ore. The demand at the moment was great. It would lie with the Government Committee to say whether they desired the applicants to obtain zinc by this method; it would not be possible now to promote a company to manufacture zinc without Treasury sanction. The applicants were the only people who knew how to make these anodes; they had actually done more work upon them than Messrs. Siemens had. The initial plant, if the Committee favoured the project, would be very expensive, and they would not be able to get to work for six months. It should be remembered, when the question of royalty was considered, that the process was mainly electrical, and the patent applied only to the anode, which was produced from the nitrate in a pan at baking heat. Applicants already had antecedent processes for treating the ore. They had a plant running for 12 months in America, but the price of zinc was not particularly good, and there was the trouble of the ore supply because of the Zink Gesellschaft's corner. Dr. Isherwood added that the zinc made electrolytically by his process was particularly suitable for all the present demands, as it came out absolutely pure. When they experimented at Mitcham they paid Messrs. Siemens a royalty of 4 marks per ton of electrolytic zinc obtained. They had the option of compounding the royalties by a lump sum, to be estimated on five years' output of 300 working days, without deducting the ton royalties already paid. Their relations with Messrs. Siemens came to an end while they were discussing the joint use of the witness's and Siemens's processes. Applicants preferred to manufacture in this country, because of the zinc shortage here.

The Controller said zinc was badly needed in England, and he should recommend that a licence be granted by the Board of Trade to the applicants, to get to work on the production of zinc at the earliest possible moment.

Vandervell *v.* A. P. Lundberg & Sons.

Judgment was delivered on Friday, December 4th, by Mr. Justice Younger, in the Chancery Division, in this action, the trial of which was reported in our issue of December 3rd.

His Lordship said the defendants had put up three defences to the plaintiff's claim. First, they said that the design was not new or original; secondly, that the numbers of the registered design had been used by the plaintiff upon switch boxes which were not covered by the protection afforded by the registration, and, therefore, the plaintiff had forfeited any right to obtain protection for the design at the hands of the Court; and the defendants lastly said that, in any case, they had not infringed the design. At the time of this registration the rules did not require, and the plaintiff, in fact, did not specify, the particulars in which his design was new and original, beyond the statement that they were switch boxes for use in electric installations, and were particularly adapted for motor-cars. The design showed a base with a particular sloping top surrounded by a beading, but it also dealt with the representation of push plugs between rows of switches, six in number, set in a plate of metal or some other substance. Two dials were also shown, and the plugs for attaching the electric connection were shown at the bottom right-hand side of the box. The plaintiff's contention with regard to the design was that it was a design for the whole structure, and not for any separate property. So far this claim that the design was novel and original was strongly supported, but looked at in that way the defendants' design was not an infringement of it. It did not resemble the plaintiff's design in that sense. But the plaintiff said the defendants had taken novel features in their design. The defendants had, as the plaintiff had, their switches arranged in a row, and six in number. Then the two dials were arranged in the sloping top of the box, which was said to be very essential to switch-boxes for motor-cars. But the registered design was not limited to switch-boxes for motor-cars. Now he thought the law was quite clear, and unless the plaintiff could get novelty and originality by taking the design as a whole, their claim failed. It was admitted that similar shaped boxes had been made and used before, and there was no novelty in, or infringement of, the design as a whole in respect of shape. He could not hold that there was anything novel or original in the number of switches so as to entitle the plaintiff to protection on that ground. With regard to the position of the switches, he could not hold that there was such a modicum of novelty and originality as would by itself justify a claim for protection, nor would it justify a claim for a combination, everything else of which was old, just because of this one novelty. He did not think, therefore, the plaintiff could justify a claim for originality at all and, on the whole, he must hold that there was not sufficient novelty and originality in this design to entitle it to be registered. To his mind there was a much broader ground on which the claim of the plaintiff ought to be rejected. As he had pointed out, this was a design for a switch-box not for a switchboard inside the box. No claim was made for the design of the switchboard, or its arrangement. He found in the plaintiff's 1910 catalogue that this was a switchboard which contained many novel features, and had been made the subject of a patent. That patent was taken out in 1909 before the switch-box was registered as a design. The design was for the box and not for the switchboard already patented. The box was designed for the board and not the board for the box. The plaintiff now claimed as part of the design of the box, a feature which was part of the board. The plaintiff was endeavouring to obtain for the switch-box an implied protection which he, as patentee, was entitled to for the switchboard. To his mind it would be a most dangerous thing to extend the scope of the Designs Act to such a claim, and if there was no other defence the objection would be fatal. Having regard to his decision on the first point, he did not think it necessary to express any opinion on the questions of forfeiture or infringement. The action would be dismissed with costs.

Wynstanley *v.* Macartney, McElroy & Co., Ltd.

Before Mr. Justice Scrutton, in the King's Bench Division, on Monday, plaintiff, May Octavia Wynstanley, claimed damages for wrongful dismissal from the post of secretary of the company; she also claimed declarations that she was the holder of 30 fully-paid £10 shares in the company, and was still secretary of the company. An injunction and damages were claimed. According to Counsel's statement, she was engaged in 1912 by the chairman of the company, Mr. J. F. Macartney, as a typist, and to teach him English grammar, spelling, &c. Mr. Macartney died in 1913, and his two sons, aged 16 and 12 respectively, were appointed directors. She was appointed a director in the month following Mr. Macartney's death, and by resolutions passed in 1915 by the two directors mentioned above, she was, she said, ousted from her position. The defendant company made a counterclaim, alleging misfeasance on the part of the plaintiff, by wrongfully converting to her own use shares which belonged to the company, and they claimed the repayment of the moneys and the transfer of the shares. They said that she was dismissed on account of grave breaches of duty, including the wrongful obtaining of certain moneys and the conversion to her own use of shares in the Malta Tramways Co., Ltd. The plaintiff said that sums of money were voted to herself and one of the directors at 5 per cent. until the proving of the will of the late Mr. Macartney, and the moneys referred to by the defendants were part of these amounts.

The hearing was adjourned until yesterday.

Osram Lamp Works, Ltd., *v.* Pope's Electric Lamp Co., Ltd.

Judgment was delivered on Wednesday, December 15th, in the plaintiffs' appeal in this action, when the appeal was dismissed.

BUSINESS NOTES.

Bankruptcy Proceedings. — J. W. Dewhurst, electrical engineer, late of 52, Northend Road, Fulham.—The public examination was held on December 8th, before Mr. Registrar Hope, at the London Bankruptcy Court. The accounts showed liabilities £152, and assets valued at £24. The debtor stated that prior to August, 1912, he was employed by his father in the above business, but then took it over and paid him £38 by monthly instalments of £1 each for the stock, tools and fixtures. He continued the business until the end of October, and then having no work in hand and no funds he closed it. Witness attributed his failure to a decline in the business since the outbreak of the war. The examination was concluded.

G. J. T. J. Parfitt, consulting electrical engineer, Keynsham, near Bristol.—A first and final dividend of 6½d. in the £ is payable on December 13th.

J. P. K. Clark (lately trading as G. Driver & Son), electrical and mechanical engineer, Hythe Road, Willesden Junction.—Application for debtor's discharge is to be heard on January 12th, at Carey Street, W.C.

Herbert Page (trading as Smeeton & Page), electrical engineer, 63, Queen Victoria Street, E.C.—Application for debtor's discharge is to be heard on January 11th, at Carey Street, W.C.

C. H. Pearson (Pearson & Co., and B.O.A. Engineering Co.), electrical, &c., engineer, Manchester.—Second and final dividend of 1s. 2d. in the £, payable December 21st, at 27, Brazennose Street, Manchester.

New Lamp Factories in Spain.—In Madrid two new factories for the manufacture of tungsten lamps are about to be started. One, apparently a German undertaking, is associated with the names of Maximos Schultz and Paul Kissted. Twenty-eight electromotors, of a total capacity of 99 H.P., are comprised in the machinery equipment. The other factory is to be established by the Franciso Perez e Lijos Sociedad en Commandita.

At Valencia is to be set up the manufacture of electric lamp bulbs by Olegario Masset, the concern, like the two above-named, being started under the protection of the Ministerio de Hacienda and the new scheme for stimulating the development of the national industries.

Dissolutions and Liquidations.—The Renew Electric Lamp Co., Ltd.—This company is winding up voluntarily with Mr. J. E. Percival, 6, Old Jewry, E.C., as liquidator. A meeting of creditors is being held to-day at the address stated.

Allan & Co., electric lighting and power engineers, 27, Endell Street, Long Acre, London.—Messrs. F. Niemeyer and T. W. Allan have dissolved partnership. Mr. Allan attends to debts, &c., and will continue the business as Allan & Co.

Wm. Sanders & Co., electrical engineers, Ridding Lane, Wednesbury.—Messrs. W. Sanders (who died on February 16th, 1915) W. Preston, and E. J. Selby, have dissolved partnership. Mr. Selby now retires. Mr. Preston attends to debts, and will continue the business under the same name.

Trade Announcements.—The Manchester Engineering Supplies Co., 45A, Market Street, Manchester, want up-to-date catalogues and price lists from manufacturers.

Messrs. Henry Faija & Co., Portland Cement Testing Works and Chemical Laboratories are removing on December 25th to 6, Earl Street, Westminster, S.W., where they have taken larger laboratories, the lease of their old premises (occupied by them for 35 years) having expired.

The Electrical Supplies Co. have moved to 233, Tottenham Court Road, London, W.C. New telephone numbers: "Museum 2516-2517." Telegraphic address: "Elecsplico, Ox. London."

Messrs. Ship Carbons, Ltd., have removed to 5, Chancery Lane, London, W.C. Telephone: Holborn 2367.

The British Trade Outlook.—We have received a pamphlet entitled "The New Outlook in Britannic Affairs," by Ben. H. Morgan, the contents being a reprint of an address delivered by the author on December 6th, before the Bristol Branch of the Royal Colonial Institute. The necessity for stimulating our export trade is referred to, the writer suggesting that one of the first things that the Government should do is to organise and stimulate production for that purpose. He says that the business of manufacturing exporters to-day is in a chaotic condition, and cites the case of a firm employing 12,000 hands which has on its books between £300,000 and £400,000 worth of export orders which it cannot execute, because its entire resources are devoted to turning out munitions. All the leading export manufacturing firms, he suggests, could be Government controlled, as in the case of munitions firms, and excess profits could be appropriated for war purposes. The question of preference in overseas purchases is discussed, and a Britannic Commercial Union is suggested. Mr. Morgan advocates a Government policy of requiring that all our Government and public departments shall place their orders with British firms, excepting where it is "inconsistent with the public good," a wide term which opens the door to many expressions of opinion. Transportation problems are briefly referred to, as is also the need for a British Empire mark of origin. In conclusion, Mr. Morgan expresses the view that in our export commerce in future great combinations will have to be met by great combinations of our own. "Manufacturers will have to syndicate their goods, and banking houses must take a broader view of their functions, and support the enterprises of manufacturers and traders." He says that the prejudice that exists in this country against large combinations or "trusts" will not diminish unless we are guided by a strong national policy, having for its object "not only the promotion of Empire industry and trade, but the maintenance of safeguards against the improper use of the great forces which we seek to create."

Book Notices.—"How to Make Low-Pressure Transformers." By Prof. F. E. Austin. Price in U.S.A., $1.10. "Directions for Designing, Making and Operating High-Pressure Transformers." By Prof. F. E. Austin. Hanover, N.H., U.S.A.: From the Author. Price in U.S.A., $2.

"The Central." Vol. XII. September, 1915. No. 37. London: The Central Technical College. Price 1s. 6d.

"*Mechanical World* Pocket Diary and Year Book for 1916." Manchester: Emmott & Co., Ltd. Price 6d. net.

For Sale.—The liquidator of "The Checkogram" is offering for sale the patents and stock, &c., of the business. Manchester Corporation is inviting tenders for the purchase of one 2,500-H.P. Yates & Thom engine and 1,500-kw. three-phase alternator, now at work at Stuart Street. Information will be found in our advertisement pages to-day.

Catalogues and Lists.—Messrs. David Rowell & Co., Ltd., 33, Old Queen Street, S.W.—Twenty-four-page illustrated price list of wire and other fencing, staircases and landings, principals for roof work, iron and timber buildings, factory buildings and workshops, and so forth.

The *Chemical Trade Journal* has issued its usual wall calendar, with monthly sheets for next year.

The Foster Engineering Co., Lpd., Wimbledon.—Circular No. 140 gives prices of Foster wire-drawn lamps for from 20 to 260 volts, and from 4 to 270 c.p.

Messrs. James McMillan & Co., Clun House, Surrey Street, Strand, London, W.C.—Sixteen-page catalogue, giving brief descriptive information, excellent illustrations, and, in some cases, prices, of portable military and rifle-range telephones, including portable magneto telephones, portable battery telephones, rifle-range telephones, and accessories.

The Bastian Electric Heating Syndicate, of 185, Wardour Street, W., has prepared a handy celluloid-measure (English and metric), which can be used either as a book-marker or as a paper-knife, and which, by means of a revolving disk arrangement, gives a calendar for from 1907 to 1927.

Fire.—As reports have been circulated that the fire at the Edison & Swan Co.'s works at Ponder's End was very serious, we have pleasure in stating the actual facts. On Saturday last a fire broke out in the joiners' shop, an extensive building of two floors, employing nearly 90 hands. The fire did not spread, but was confined entirely to that department. The self-contained nature of the Ediswan works enabled things to be set going by Monday morning when work was resumed.

Electric Cooking Installation.—The Jackson Electric Stove Co., Ltd., has obtained an order for fitting up an electric cooking installation at the new Phœnix Assurance Buildings in King William Street, E.C. It will consist of large ovens, boiling pans, hotplates, fish boilers and fryers, hot cupboard, grills, &c.

LIGHTING AND POWER NOTES.

Aberdeen.—New Plant.—Mr. Bell, the city electrical engineer, recently submitted a proposal, which was adopted by the Electricity Committee, for extending the generating plant, at a cost of £21,175. In his report Mr. Bell pointed out that the plant consisted of 4,000 kw. of A.C. and 4,380 kw. of D.C. machinery, which in view of the increasing demand was insufficient. In particular this referred to the A.C. supply which depended on the 3,000-kw. set not being rendered inoperative for any time in the winter months. This set Mr. Bell reported had up to a recent date generated 19 million units; in 20 months it had saved after paying all capital charges, £2,490, and would with the present coal prices, pay for itself in another 18 months. He recommended that a 5,000-kw. turbo-alternator, with condensing plant, switchgear, &c., and a 1,000-kw. motor-converter with switchgear, be obtained. The recommendation of the Committee was, however, rejected by the T.C. at its meeting on December 6th, by 17 votes to 14.

Ashton-under-Lyne.—The electrical engineer having reported difficulty in maintaining supplies, a Sub-Committee is to consider the desirability of using a railway siding near the works, the erection of a conveyor, and the purchase of a motor wagon. It has been decided that power accounts of £10 per month and over be collected monthly instead of quarterly.

Atherton.—Price Increase.—The South Lancashire Tramways Co. has notified the U.D.C. that in consequence of the increased cost of coal, the price charged to the Council for electricity supplied during the year commencing January 1st, 1916, will be increased 1d. per unit.

Australia.—The Melbourne City Council has concluded an agreement with the Melbourne, Brunswick and Coburg Tramway Trust for the supply of electric current for a period of five years; the price to be paid by the Trust is £5 per annum for each kw. of demand and 0·65d. per unit for current supply.

The city electrical engineer is to visit Sydney in connection with the formulation by the Federal Council of the Electrical Association of Australia, of a uniform set of conditions of contract for public tender.

The Shire Council of Upper Yarra (Vic.) has applied for an Order-in-Council to supply electricity to the townships of Warburton, Millgrove, West Warburton, and Yarra Junction.—*Tenders.*

Bolton.—Proposed Loan.—Sanction is to be asked by the T.C. to the borrowing of £2,215 for mains and transforming plant.

Burton-on-Trent.—Proposed Loan.—The T.C. has decided to apply for sanction to borrow £3,500 for cables, in accordance with the recommendation of the Electricity Committee.

Continental.—Russia.—A group of contractors has submitted to the T.C. of Rostoff on the Don a proposition to erect a third electrical station on a concession basis, including the Council as a shareholder. A committee of the town engineers is examining the proposition.

The Tabreez Government has approved the project of an electrical station to be erected in Alupka, besides a system of electrical distribution for Alupka, Sara, Mischora and Simeisa.

The Belgian Company, of Simferopol, in agreement with the management of the Simferopol Railway Station, is negotiating with a view to introducing electric current for lighting the station, and at the same time, the Gorodetz Factory.

As the Chabarovak electricity station is over-loaded, and can only deliver current to the garrison buildings, &c., for limited periods in the evening, it is proposed to install a separate electric station for the use of the military department.

The Mozyr (Minsk Government) Council propcses to grant a concession to Messrs. Mikulitzky & Smolyansky for the installation of an electric lighting system in the town.

The Government of the town of Vitebsk has received notice from the Minister of the Interior, of the approval of the decision of the Vitebsk T.C. to establish as a share company, the "Vitebsk Tramways" concession for the construction and exploitation in the town of Vitebsk of electric light, and of the conditions attached thereto as approved by the Vitebsk T.C. for the concession.

Chesterfield.—Plant Extensions.—The T.C. is recommended to couple a 400-kw. D.C. generator, which is being displaced by an alternator, to an A.C. motor, in order to give additional plant capacity, at an estimated cost of £1,800. It is also proposed to equip four additional boilers with coke-breeze burning apparatus, at a cost of £219.

Darlington.—Loan Sanction.—The Corporation has received the sanction of the L.G.B. to the borrowing of £15,600 for new plant. Of this amount, £12,800 is required for a turbo-generator, condensing plant, &c., switchboard and cables, and £2,800 for a mechanical coal-handling plant. The tender of Messrs. Fraser and Chalmers for a 3,000-kw. turbo-alternator has been accepted.

Dover.—A loan of £157,519 to the Corporation Electricity Committee by the Trustees of Greenwich Hospital, is due for repayment next May, and the Committee has been informed that the Trustees have been recommended not to renew the loan at 4 per cent. Negotiations for the renewal are proceeding.

Downham Market.—E.L. Scheme.—The U.D.C. has offered to discuss with Mr. C. H. Best, of Bradford, a scheme of E.L. for the town, on the distinct understanding that the Council will not incur any pecuniary liability.

Ellesmere Port.—Prov. Order.—The B. of T. has informed the U.D.C. that it is not prepared to grant the Council a prov. order for E.L. unless some urgent reasons are adduced.

Fakenham.—E.L. Scheme.—The P.C. has decided not to consider the question of electric lighting during the war.

Folkestone.—Street Lighting.—Owing to the lighting restrictions, the Electricity Co. has made a further reduction in the Corporation street lighting account at the rate of £72 per quarter in addition to the rebate of £112 per quarter allowed when the lighting was first reduced. This has been accepted by the T.C.

Gillingham (Kent).—Price Increase.—The T.C. has decided, owing to the increased cost of fuel, &c., to add to each account for current 10 per cent., and to ask the other consumers having contracts whether they are prepared to pay the increase.

Hertford.—New showroom premises in the town have been opened by the North Metropolitan Electric Power Distribution Co., Ltd.

Heywood.—Price Increase.—The charges for electrical energy are to be increased as from January 1st, 1916, by 5 per cent. for lighting purposes, and 10 per cent. for power purposes.

Keighley.—Water Pumping.—The Corporation has decided to put down plant, including a motor to cost about £100, for pumping water from a well belonging to Fleece Mills Co., into Black Hill reservoir.

Kilmarnock.—Year's Working.—During the year ended May 15th last, the Council's electrical undertaking sold 2,681,607 units, being a small increase on the previous year. The net profit on the undertaking was £3 726 against £3 825 in the previous year. The generating plant capacity now amounts to 3,030 kw.; 800 kw. of rotary sub-station plant and 1,315 k.v.a. of transformer sub-stations are supplied, and 18¼ miles of 11,000-volt overhead lines are in use. In the Kilmarnock area 2,558 h.p. of motors, and in the outer area 1,570 h.p. of motors—a total of 4,128 h.p.—are supplied. The total working costs amounted to ·512d. per unit sold, coal costing ·157d. per unit, with coal at 4s. 2d. per ton.

Kingston-on-Thames.—L.G.B. Inquiry.—An inquiry was to be held during the week into the application by the T.C. for sanction to a loan of £16,792 for the electricity undertaking.

Llanelly.—Street Lighting.—The Council has decided, by 9 votes to 3, to substitute small lamps for street arcs during the period of the war.

London.—School Lighting.—In July, 1914, the London Education Committee accepted the tender of Messrs. Turnham & Co., at £1,050, for installing electric light, bells and telephones in the Furzedown Training College and Hostels, Wandsworth. The contractors have now submitted a claim for £38 13s. in respect of the increased cost of the work, which the Committee has agreed to pay. A three-story building for boys, girls and infants and a separate boys' school have been erected in Vallance Road, Whitechapel, and the wiring has been completed. As a result of negotiations, the Stepney B.C. is now prepared to lay the services, on the understanding that the cost is borne in the first instance by the Council, to be refunded on the termination of the war.

It was reported at last week's meeting of the Lambeth B.C. that the South London Electric Supply Corporation, Ltd., had given notice to its consumers that an addition of 9 per cent. will be made to the charges for current supplied, as from the date of the December meter readings.

The Metropolitan Water Board proposes to enter into an agreement with the Battersea B.C. for the supply to the Battersea station of current at 1d. per unit for power and 3½d. per unit for lighting, plus a temporary increase of 10 per cent.

Islington.—The L.C.C. has sanctioned the borrowing by the B.C. of an amount not exceeding £5,455 for electricity mains within the borough.

Hospital Lighting.—As the result of negotiations the Metropolitan Asylums Board proposes to enter into a new agreement with the South London Electric Supply Corporation, for the supply of electricity to the South-Western Hospital and Ambulance Station. The agreement is to be for a period of seven years from October 1st last, and at the following scale of charges:—For the first 12,500 units per annum 4½d. per unit, in excess 2d. per unit, the Board undertaking to take at least 20,000 units for lighting each year. For power, heating, and cooking a flat rate of 1½d. per unit.

St. Pancras.—The Finance Committee has had under consideration a letter received from the Comptroller of the L.C.C., relative to the sanction asked to the borrowing of £13,000 in connection with the King's Road electricity extension. While it appears the L.C.C. Finance Sub-Committee is under the impression that the first two boilers cannot be obtained owing to the war, and, therefore, it would be unnecessary to proceed with the buildings to accommodate them, the British Niclausse Boiler Co. offers delivery of the boilers by autumn, next year. In view of this it is proposed to renew the application to the L.C.C., and to inform the Boiler Co. as to the course of events, with a view to installing the boilers by the specified dates. The Ecclesiastical Commissioners have agreed to advance the loan required for the boilers, the option expiring on March 25th next.

Hampstead.—A small fire occurred at the Council's generating station on Wednesday night, resulting in damage to machinery and switchgear, and a 20 minutes' failure in the supply.

Loftus-in-Cleveland.—Street Lighting.—The Council has decided to make a grant to Messrs. Pease & Partners, Ltd., who were responsible for the electric lighting in the district, on account of the reduced revenue consequent upon the lighting restrictions. Taking a basis of £200 for the full year, the firm will be apportioned a sum according to the number of times the lamps have not been lighted.

Loughborough.—Half-Year's Accounts.—Ald. Bumpus, in reviewing the work of the electricity department for the half-year, mentioned that there was a large increase in output of energy, mostly for power purposes. The lighting receipts were slightly decreased, but the gross profit was £878, as compared with £517 a year ago.

Manchester.—New Plant.—Owing to the increasing demand for electricity and the impossibility of completing any part of the new Barton power station in the required time, the Electricity Committee proposes to temporarily install one of the 15,000-kw. generating sets intended for the Barton power station, at the existing Stuart Street station, making room therein by removing a generating set of 3,750 kw., which is some 11 or 12 years' old.

Morley.—New Plant Proposals.—The electrical engineer (Mr. J. E. Ellis) has reported to the T.C. that owing to the increase in load on the generating station, the margin of reserve plant is becoming exhausted, and new plant should be obtained, to be in working order by September next. He adds that, from the standpoint of efficiency alone, up-to-date plant could be obtained that would generate current at one-half of the cost of generating with the present plant. The Electricity Committee has, however, decided that it cannot carry out the work, which would probably cost £2,000.

Newcastle (Co. Down).—The manager of the Electric Light Co., in response to the Urban Council's request, states that, owing to the high cost of materials, it is impossible for the company to install electricity in workmen's houses in the town at present.

Nuneaton.—The L.G.B. has intimated in reference to the Council's application for sanction to the raising of a loan of £10,000 for electrical extensions, that it would not take exception to the Council entering into contracts for the plant.

Redditch.—Proposed Loan.—The U.D.C. has decided to borrow a further £12,542 in connection with the reconstruction of the electricity undertaking. The original estimate of the cost of the scheme was £28,900, of which £25,000 has already been borrowed. With the present application the total cost is increased to £38,127.

Rotherham.—New Plant.—The T.C. has been authorised to purchase a 5,000-kw. turbo-alternator from the British Westinghouse Co.

Sheffield.—Proposed Loan.—Application is to be made to the L.G.B. for sanction to the borrowing of £137,104 for the provision of an additional turbo-alternator, with necessary boilers and auxiliary plant, at the Neepsend power station.

Stretford.—The U.D.C. is recommended to reappoint Mr. Thos. L. Miller as consulting engineer in connection with the electrical undertaking, for a further period of 12 months, at a fee of 25 guineas.

Torquay.—The T.C. has decided that the Tramway Co. be asked to pay an additional ½d. per unit for traction current supplied.

West Ham.—The electrical engineer has reported in detail on the existing arrangements for the supply of feed and make-up water at the generating station, and has submitted estimates for extensions and alterations which were provided for in a past loan sanction. This work is estimated to cost £1,350; the unexpended balance of the loan sanctioned is, approximately, £1,100, and the balance of £250 will be defrayed, if necessary, out of current revenue.

Walsall.—In a recent report by the Electricity Committee, attention was drawn to the serious increase in coal consumption at the electricity works. This position had been anticipated, in view of the necessity of bringing into use old and inefficient machinery, owing to the backward condition of the new works, which, it was expected, would be in use this winter.

The Electricity Committee has agreed to reduce by 25 per cent. the charge to the Property Committee for lighting the lamps outside the Council House.

West Bromwich.—Price Increase.—The Electricity Committee recommends the T.C. to increase the price of energy to ordinary power consumers by 15 per cent.

Whitehaven.—A Sub-Committee of the Corporation Lighting Committee has been appointed to go into the question of the general working conditions at the electricity station, and present a report. It is considered that additional plant may be necessary in the near future.

Wigan.—According to the *Wigan Examiner*, a lengthy discussion recently took place on a breakdown at the electricity works, where, on a certain Saturday night, it appears that seven boilers of the eight installed were out of service on account of burst tubes. The boilers in question, mostly old ones, have been forced for some time, and two new Stirling boilers are on order to assist matters; the condition of the boilers is attributed to the indifferent water supply, to improve which water softening plant has been installed, but with poor success owing to the erratic character of the water.

Wolverhampton.—The B. of T. has granted permission to the Corporation to supply energy to the Sewage Outfall Works at Barnhurst.

Worcester.—The borough electrical engineer has been authorised to fix a new switch panel at the Hylton Road station at an estimated cost of £32.

Wrexham.—Prov. Order.—On account of conditions arising out of the war, the T.C. has decided to defer for the present the application for a prov. order extending the area of supply into the rural district.

TRAMWAY and RAILWAY NOTES.

Bingley.—Tramway Extension.—The U.D.C. has applied to the B. of T. for an extension of time from February 7th, 1916, to a year after the termination of the war, for the completion of the new tramway from the terminus at Crossflats to the Council's boundary adjoining the area of the Keighley R.D.C.

Birmingham.—The Tramways Committee has decided, in view of the strenuous traffic conditions prevailing, to shut down the tramway and 'bus services on Christmas day in order to give the employés a rest.

Bournemouth.—Tramway Reconstruction.—The T.C. has decided, subject to the consent of the Treasury, if it be necessary, to borrow temporarily by loan from the bankers, and afterwards by mortgage on the rates, £6,000 for the reconstruction of a portion of the tramway track between the town and Poole at Constitution Hill. The B. of T. has raised no objection to the project.

Continental.—Russia.—At a recent meeting of the Karkoff T.C., a proposition of the General Electrical Co. respecting the sale of land, &c., was accepted. After explaining the terms of the bargain, the notice states that the Russian General Electrical Co. has undertaken to introduce, on account of the town, a tramway line, beginning from the Petinsk line, and running to the recently-acquired property. The cost will be paid off in three years in equal sums; the company is to begin construction at once. The town will supply the company with power at 5¼ farthings per KW.-hour.

Darwen.—The General Purposes Committee has declined an application by tramway employés for an advance in wages.

Lanarkshire.—An arrangement has been made whereby the possibility of the County Council acquiring the tramway system will be kept open till after the war.

Leyton.—Female Conductors.—The U.D.C. has decided to train female conductors for the tramways, preference to be given, except in special circumstances, to single women or widows. During training they will receive 12s. 6d. per week, and afterwards a wage of 7½d. per hour.

London. — Vehicle Battery Maintenance. — The Metropolitan Asylums Board proposes to enter into an agreement with the Tudor Accumulator Co., for the maintenance of the battery of the new 30-cwt. electric vehicle at Queen Mary's Hospital. The agreement is for five years, the amount charged per mile run being 1½d.

Northampton.—Female Conductors.—The T.C. has decided to train some female conductors for the tramcars, and to pay them the same wage as received by men.

Sheffield.—The City Council has confirmed the Tramways Committee's proposal to suspend the tramway service on the Sunday following Christmas Day. Sir William Clegg, the chairman of the Committee, said it recognised that the proposal was somewhat drastic. There were now 400 women in the employment of the department, and the number was rapidly increasing. The number of passengers carried per day was 350,000, and the excess per week, compared with last year, was about the same figure. They were running between 1,100 and 1,200 miles more than in the corresponding period last year. Each evening they had to turn out over 100 part-day or special cars to meet the increased traffic. They anticipated that in the week before Christmas the staff would be overwhelmed, and he was quite sure that unless advantage could be taken of the special circumstances, the time would come when they would break down physically.

TELEGRAPH and TELEPHONE NOTES.

Cable Censorship.—It was announced on Monday last that censorship by the Press Bureau, on behalf of the Foreign Office, would be suspended from December 20th; the responsibility for matter telegraphed abroad would rest with the senders of the telegrams, but the censorship of Press telegrams from one foreign country to another over British cables would remain unaltered. The censorship of naval or military matter will continue as before.

Illicit Wireless. — The wireless apparatus on the German steamer *Bulgaria*, which is interned in the harbour of Baltimore, U.S.A., has been sealed by order of the United States Government, owing to charges that messages have been sent and received by it recently.

Russia.—The chief Department of Posts and Telegraphs has allocated a sum of 100,000 roubles for converting the overhead telephone system of the Saratoff district into an underground one. The work will begin in the spring; in the meantime the necessary material will be prepared.

Until now, between Tomsk and Omsk there has only been one telegraph line, which has proved altogether insufficient; to relieve this line, a supplementary line *viâ* Novo-Nikolaievsk-Omsk has now been installed.

The Poltava Government is asking the Ministry of the Interior for permission to construct a telephone line from Poltava to Kremenchy. The work will be started immediately.

Submarine Detectors.—In the *Scientific American* of October 16th, it was stated that a means had been found for detecting the approach of submarine vessels at a great distance, with the aid of Mr. W. Dubilier, whose name is known in connection with wireless telegraphy. It was not difficult to detect the sound of propellers by means of submerged microphones, but these sounds could not be distinguished from those emitted by the propellers of surface vessels. However, after numerous experiments, a characteristic sound associated only with the propellers of submarine vessels was identified, and eventually methods of filtering out other sounds were developed, while the sensibility of the receiving apparatus was increased by means of the De Forest amplifier, so that it became possible to detect the approach of a submarine at a distance of over 50 miles; the employment of a number of microphones arranged so as to possess maximum sensibility in particular directions enabled the direction of the submarine to be discovered, and a method not disclosed was found of estimating the distance of the submarine.

Wireless Telegraph Relay.—It is reported that Dr. R. E. Hall, at the University of Michigan, has perfected a relay for wireless telegraphy which operates on the principle of tone instead of wave-length tuning, and makes possible the sending and receiving of messages simultaneously on the same antenna; it will automatically relay wireless messages to a wire telegraph line, and records the messages on tape at a high speed.—*Telegraph and Telephone Age.*

Wireless Telephony.—Prof. Pupin in a lecture recently described the device which he has invented for increasing the range of wireless telephony. He states that it eliminates all disturbances and static discharges, and selects only the waves conveying the message.—*Telegraph and Telephone Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Birkenhead.—December 20th. Unwashed rough slack for the Corporation's electricity generating stations, during period ending June 30th, 1916. Mr. G. P. Shallcross, Borough Electrical Engineer, Craven Street.

Australia.—Adelaide.—January 19th. P.M.G. Common-battery switchboard. See "Official Notices" November 19th.*

January 26th. Deputy P.M.G. Twenty tons of galvanised-iron wire, 400 lb. to the mile.*

January 26th. Deputy P.M.G. Telephone instruments, parts and accessories.*

Brisbane.—February 23rd. P.M.G. Wheatstone apparatus. See "Official Notices" to-day.

Sydney.—January 31st. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

Nuneaton.—December 24th. Corporation. Supply and erection of an overhead line, for the Electricity Department. See "Official Notices" December 10th.

Redditch.—December 28th. Council. Eighty tons per week, for three months, of D S. nuts or rough slack. See "Official Notices" December 10th.

Salford.—2,000 tons of washed slack for the electricity works, Frederick Road. Chairman of Electricity Committee.

South Africa.—Durban.—January 5th. Corporation Telephone Department. (1) Telephone apparatus and materials; (2) underground cables; (3) 540 c.i. pipes, 9 ft. long, for cables. Messrs. Webster, Steel & Co., 5, East India Avenue, E.C., are the Corporation's London agents.*

Spain.—December 21st. Municipal authorities of Calanas (Province of Huelva). Concession for the electric lighting of the town during a period of ten years.

December 20th. Municipal authorities of Vich (Province of Barcelona). Concession for the electric lighting of the town during a period of three years.

Municipal authorities of Mola del Marques (Province of Valladolid). Concession for the electric lighting of the town.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Aberdeen Line.—This company has accepted the tender of Messrs. Siemens Bros. Dynamo Works, Ltd., for Wotan, tantalum, and carbon lamps, for the year 1916.

Australia.—The following contracts have been placed:—

Commonwealth Railways.

Portable telephones, £530.—Western Electric Co. (Aust.), Ltd.

Metropolitan Board of Water Supply and Sewerage.

Centrifugal pumps and motors (Richmond pumping station), £1,827.—Zollner, Ltd. (including motors supplied by General Electric Co. of America).

P.M.G.'s Department, Sydney.

Supply of distributing-cable terminals, £1,900.—The Oliver Co.

Metal-filament lamps, £517.—Dick, Kerr & Co.

17 strips metallic circuit-protectors and mounting plates, £935.—Western Electric Co. (Aust.), Ltd.

5,000 ft. glazed earthenware conduit, two ducts; 2,500 ditto, three ducts; 30,000 ditto, four ducts, £2,677.—Sydney Stoneware Pipe Association.

P.M.G.'s Department, Melbourne.

Telephone cords, &c., £335.—Laurence & Hanson Electrical Co., Ltd.

Telephone diaphragms and microphones, £154.—600 common-battery telephones, £1,600.—Western Electric Co. (Aust.), Ltd.

Victorian Railways.

Electrification of Melbourne Suburban Railways, sub-station building at Albion, £13,073.—J. S. G. Wright. —*Aust. Mining Standard.*

Gillingham (Kent).—The T.C. has accepted the following tenders for coal for the electricity works:—

Gill & Son, Ltd.—100 tons of Notts Gedling 1½-in. nutty slack, at £1 4s. 5d. per ton, and 100 tons of Notts Ruff ord 1½-in. nutty slack, at £1 3s. 10d.

Spencer, Whatley, Ltd.—500 tons of North Staffs 2-in. and ½-in. D.S., at £1 6s. per ton, and 50 tons of Snibson Deep 1½-in. slack, at £1 1s. per ton.

Glasgow.—The Hyatt Roller Bearing Department of Messrs. Broom & Wade, Ltd., has secured an order from the North British Locomotive Co., Ltd., of Glasgow, for 350 three-inch Hyatt roller bearing drop hangers complete, to be installed in their new works.

London.—The L.C.C. has accepted the tender of the Maxim Lamp Works, Ltd., for an annual supply of electric traction glow-lamps for the Tramways Department.

Morley.—The T.C. has accepted the tender of Messrs. Bedford & Co. for coal for the electricity works.

Newport (Mon.).—The Borough Electrical Engineer has been authorised to order 300 tons of Bedwas navigation coal, at 14s. 6d. per ton, and 300 tons of Crumlin Valleys coal, at 12s. per ton.

Nuneaton.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for pipework for plant extensions at the electricity works, at £330.

Owing to the satisfactory operation of the 750-kw. geared Curtis turbo-generator that was supplied by the British Thomson-Houston Co., Ltd., the Corporation has now placed with the company an order for a duplicate set.

Torquay.—Messrs. E. P. Bovey & Son have written to the T.C. intimating that, in view of the difficulty of delivery of materials, they could not guarantee completion of the electrical work of the new Medical Baths in any definite time, and must therefore let the work pass. The Baths Committee has resolved that, providing Messrs. Bovey will complete the work within four weeks from the date the materials for the job are on the site, their tender be accepted, but failing this, that the next lowest tender be accepted.

Wolverhampton.—The Tramways Committee has accepted the tender of Messrs. Hadfields, Ltd., at £595, for the supply of 14 pairs of points.

Worcester.—The City Council has confirmed the acceptance of the tender of the Pulsometer Engineering Co., Ltd., amounting to £192, for supply of a centrifugal motor-driven pump, with crab, &c., for the detritus well.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, December 17th. At 6 p.m. At 11, Great George Street, Westminster, S.W. Paper on "Engineering Colleges and the War," by Dr. R. M. Walmsley and Mr. C. E. Larard.

Electro-Harmonic Society.—Friday, December 17th. At 8 p.m. At Holborn Restaurant. Smoking Concert.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, December 17th. At 7.30 p.m. At Bolbec Hall, Newcastle. General Meeting.

University College, London.—Friday, December 17th. At 5 p.m. Final Lecture on "Electric Heating and Electric Furnaces," by Prof. J. A. Fleming, F.R.S.

Manchester Association of Engineers.—Saturday, December 18th. At Grand Hotel, Aytoun Street, Manchester. Topical Discussion Evening.

Junior Institution of Engineers.—Monday, December 20th. At 7.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "The Modernisation of Power Plant in Factories," by Mr. W. A. Tookey.

Salford Technical and Engineering Association.—Monday, December 27th. At 7 p.m. At the Royal Technical Institute, Peel Park. Annual Social.

FUTURE TRADE WITH RUSSIA.

It may be not without interest to hear what our French friends have to say in regard to the cultivation of commercial relations with Russia, on the principle that it is always advisable to learn something, if possible, from our neighbours, just as the latter seek information from us. That the French are hopeful of securing advantages in Russia after the war is shown by the fact that the Minister of Foreign Affairs appointed a Commission some time ago, under the presidency of M. Méline, to co-ordinate the good wishes scattered about in respect to the promotion of business, and the Commission itself obtained the services of a Consultative Committee, composed mostly of leaders of commerce and industry, to make inquiries in circles interested in trade with Russia, and collect the suggestions for the consideration of the public authorities. The results of the investigation, together with the Committee's recommendations, were recently published in a general report by M. Pierre Arbel, which is divided into two parts, one dealing with the standpoint of German trade with Russia, and the other with that of France with that country. We do not observe anything particularly new in the German part, but it is well not to overlook the statement that, in order to develop the export trade at any cost, the German people, with the Government at the head, have consented to pay in the home market prices which are much higher than the export prices, calculating that the high inland prices were only a displacement of riches without vexatious recoil on the general public, whilst, on the other hand, all the transactions effected abroad would cause an influx of money profitable to the nation. The report states that this was the origin of the export bounties, by means of which the Germans found a practical and efficacious method, not only of favouring their exports, but also of annulling the natural effect of Customs duties, and the Committee remarks that not one of the least preoccupations of the negotiators of the future Peace Treaty should be to provide a remedy for this matter.

The second part of the report, dealing in general with the difficulties which have hampered French exports to Russia in the past, enumerates these as the lack of qualified commercial representatives and travellers knowing the language, the absence of information concerning Russian customers, and the fear of having to grant long credits. It is, however, noted that the French Chamber of Commerce in Paris, the Russian Chamber of Commerce in Paris, and the Russo-French Chamber of Commerce in Petrograd, together with the public authorities, have endeavoured, since the declaration of war, to place the necessary information at the disposal of exporters, including details of business such as concerns goods required or offered in Russia, and of offers of co-operation made by Frenchmen or persons not acquainted with French, living in Russia. The education of young men in commerce and in Russian is being undertaken, so that it will be possible to dispense with German intermediaries in future; whilst in the case of trade credit, it is held that an entirely new organisation has to be created. The French banks and the Bank of France in particular ought to discount long term drafts on other countries. But the report emphasises the necessity for the establishment of an export bank with the co-operation of the State, and states that if such an

institution could not be formed at once, it would be possible to include English and Russian capital for the same purpose. A matter of considerable importance is raised in regard to the clearance of goods through the Russian Customs-houses, where the Allied Administration is blamed for causing trouble. It is therefore suggested that in order to provide a remedy Customs-houses as in Russia should be established in Paris and in the principal French seaports to receive declarations, undertake verifications and levy the duties, so that the cases or bales sealed by the Russian officials would be admitted into Russia after a simple confirmation. We do not notice in this connection any reference to the pledge which was recently given, when in Paris, by the Russian Minister of Finance, who promised one of the French ministers that he favoured the opening of such Customs-houses and would endeavour to secure their establishment.

The report also discusses particular cases of Franco-Russian imports and exports. Leaving out of consideration the question of coal, we can associate ourselves with the opinion expressed by the Consulting Committee that France—Great Britain also—should furnish at least a portion of the iron and steel materials intended for works, pledged by loans issued in France or Great Britain, for water, gas and railway concessions, &c., and that a special tariff should be obtained for application to metallurgical products imported into Russia, owing to the inadequacy of the native production. In the case of machinery, France exported only 7,500 tons to Russia in 1911 out of the 300,000 tons imported into that country in that year, and it is admitted that the French can only think of exporting more largely when they have reorganised their mechanical engineering industry. Coming to consider the problem of electrical machinery, we now find a further explanation for the great preponderance of German types in Russia in the past—an explanation which, even where unknown, followed naturally from the fact that Teutonic electrical material previously formed 92 per cent. of the total imports of this class into Russia. Its interpretation is that the Verband Deutscher Elektrotechniker secured the adoption of its constructional regulations in Russia, and now the Consulting Committee contends that it will be possible for French electrical firms easily to compete with Teutonic industry if they can obtain the substitution of the regulations of the Union des Syndicats d'Electricité. By all means let us supersede the Teutonic methods, but let the Allies, if possible, try and arrange a common basis for future work. In conclusion, the report refers to public works in general, and suggests that the French Government could take useful action when foreign loans are proposed in the French market, so that the flotation of such loans should be accompanied by an increase in the activity of French industries, and no longer serve for the assistance of competitors; and that the Russian Government should henceforth grant to French manufacturers a considerable part of the orders for works to be carried out and deliveries to be effected.

We were under the impression that the French Government had for years past made it a constant condition that foreign loans should be accompanied by, or be contingent on, orders, and assume, therefore, that a stricter adherence to this practice is desired in the future. It is precisely a policy of this kind which is urgently needed in Great Britain. A Government alone can make suggestions in the right spirit, and if these are not acted upon, it is possible for a Government to command the attention of banking and other financial institutions concerned. We have sent millions of pounds out of this country which have frequently been used for payment for orders placed with *our* foreign competitors! If public issues can be controlled now, how much more essential will it be for foreign emissions to be regulated for mutual benefit after the war; for reciprocity there must be.

NOTES.

Institution and Lecture Notes.—Royal Institution.—With reference to the list of events announced in our last issue, we have now received the complete programme of arrangements, from which we select the following:—

January 21st.—"Problems in Capillarity," by Sir James Dewar.
February 18th.—"Polarised Light and its Applications to Engineering," by Prof. E. G. Coker.
March 3rd.—"Corona and other Forms of Electric Discharge," by Prof. S. P. Thompson.
April 14th.—"The Genesis and Absorption of X-rays," by Prof. Sir J. J. Thomson.
January 20th and 27th and February 3rd.—Three Lectures on "Utilisation of Energy from Coal," by Prof. W. A. Bone.
March 16th and 23rd.—"Organic Chemistry in War," by Prof. H. E. Armstrong.
March 11th, 18th, 25th, April 1st, 8th, and 15th.—"Radiation from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Institution of Electrical Engineers.—A meeting of the Western Local Section was held at Cardiff on Monday; the attendance was comparatively small. Mr. J. R. Beard read a paper on "The Design of High-Pressure Distribution Systems," and Mr. W A. Chamen, who presided, drew attention to the remarkably large number of sub-stations and generating stations that the Newcastle system now possessed. He said it would be interesting if they could know what would be the effect if some of these sub-generating stations by accident suddenly ceased giving a supply. Were the arrangements such that any one of them could shut down and still allow others to go on without interruption? Mr. Allan, the local secretary, also spoke, and a hearty vote of thanks was accorded to the author.

The Committee of the Manchester Students' Section of the Institution has decided to cancel all meetings this Session.

Institution of Civil Engineers.—On Tuesday last, the "James Forrest" lecture, written by Mr. H. M. Hobart, was read in abstract by Mr. J. A. F. Aspinall. The subject of the lecture was "Electrical Railways," and the paper, as read, appeared to consist almost wholly of working data and statistics relating to recent progress in electric railway operation in the United States. After an introduction outlining the extraordinary reduction in capital cost and improvement in efficiency of electrical plant during the past 20 years, the author described the methods adopted for the application of electrical haulage to the Butte, Anaconda and Pacific Railway, and the Chicago, Milwaukee and St. Paul Railway. From the mass of figures that were given it was clear that as the result of electrification the economies that were effected in comparison with steam were very substantial. On the Chicago railway regenerative operation is being adopted, and is expected to effect a marked reduction in working costs. During the meeting a telegram from the author was read stating that on the Chicago railway a 2,500-ton load, 12 per cent. over the guarantee, was hauled up a 20-mile section including grades up to 2 per cent. by an electric locomotive weighing 250 tons, and descended under regenerative control, returning energy into the 100,000-volt system. The author concluded his lecture with a statement to the effect that direct current was the best for heavy traction, and that high-pressure D.C. supply through overhead conductors had been proved successful.

The railways above referred to were respectively described in the Electrical Review, on March 27th and April 3rd, 1914, and November 5th, 1915.

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for fortnight commencing December 20th, 1915.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, December 20th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, December 21st.—School of Arms with Architects Corps, 6 to 7 p.m.

Thursday, December 23rd, to *Thursday*, December 30th inclusive.—Headquarters closed.

Friday, December 31st.—Social evening, 6.15 to 8.15.

Saturday, January 1st.—Uniform parade.

Officer for the Week: Monday, December 20th, to Saturday, January 1st, Mr. Corbett.

Platoon on Duty.—Monday, December 20th, to Saturday, January 1st.—No. 2 Platoon. Platoon on duty has to provide a piquet for Headquarters of one N.C.O. and three men, and also one N.C.O. for instructing recruits.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W. Sections for Shooting Parade at Miniature Ranges. Unless otherwise ordered, all Parades at Chester House.

E. G. Fleming,
Acting Adjutant and Company Commander.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, December 16th, 1915:—

Week-end Parades.—Saturday.—The Battalion will parade at Baker Street Station 2.30 p.m. and proceed by train to Neasden Station, detrain, and proceed by march route to Wembley Camp.

Sunday.—7 a.m., Réveillé; 10 a.m., Church Parade; 10.20 a.m., Parade under Company Officers; 2.15 p.m., Parade under Platoon Commanders; 5 p.m., Lecture on Signalling (Maintenance of Communication—use of latest appliances), by Lieut. Reed, Gloucester Regiment (late member of the Corps).

Musketry.—Inter-Platoon Competition.—Acton Range will be open on Saturday next, the 18th inst., for practice in above competition, for those men only who have sent in their names (limited to 20) to the Musketry Staff. Shooting—11 a.m. to 1 p.m. and 2 to 4 p.m. It is hoped that as many men as possible will make it convenient to shoot during the morning.

There will be shooting at Bisley on Saturday next, the 18th inst. Members must report themselves to Sergeant Cotter at the barrier of No. 9 Platform, Waterloo Station, at 12.45 p.m. Names must previously be sent in to Headquarters.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Patents and Alien Enemies.—Application has been made to the Board of Trade in respect of Patents Nos. 26,297/04, 21,750/09, 24,389/10, 19,473/11, 16,165/12, 218/13, 1,179/13, and 25,180/13, granted to Th. Goldschmidt and his associated company, for the welding of rails, by the British Thermit Co., Ltd.

The Board of Trade has published a notice in the *London Gazette* restating and extending the provisions of the Licence, dated November 14th, 1915, with regard to the payment of fees in respect of the Registration of Patents in enemy countries.

London Electrical Engineers, R.E. (Territorial Force).—The Corps of London Electrical Engineers is again open to recruiting. Men of the following professions and trades are specially required:—Mechanical and electrical engineers, electricians, engine drivers, engine erectors, instrument repairers, metal turners, fitters, telephonists and telegraphists, and tinsmiths. There are a limited number of vacancies for carpenters, cabinet makers, pattern makers, draughtsmen, joiners and wood turners. Forms of particulars can be obtained from the Officer Commanding, at 46, Regency Street, Westminster, S.W.

Earnings of Engineers.—The *Daily Chronicle* states that the membership of the Amalgamated Society of Engineers has advanced from 173 629 to 204.162 in 11 months, and the funds have increased by £237,070 in 10 months. It is estimated that, taking into account increases in weekly wages, increase in piece work prices and amount of overtime, the earnings of members must have increased by about 2 million pounds per annum.

Who Will Assist?—Mr. H. Scholey, writing further with reference to the case of the Belgian mentioned by him in our issue of November 26th, says:—

"I have been interesting myself in the case of a Belgian merchant who, prior to the war, occupied a very important position in the city of Antwerp, but is now practically stranded. He is a man of unusual education, and I felt that there ought to be no difficulty in securing him a temporary position. I obtained an introduction for him to a large firm, who made a half promise that they would find him work, but after the interview which my friend had with this firm, we were both disappointed to find they were unable to do anything for him. You will be interested to observe the conclusions which my friend arrived at, and it constitutes a rather serious criticism of the methods adopted by Relief Committees.

To me the fact lies somewhat deeper. In fact, the Belgians have been spoilt by you Englishmen. You gave them too much money when the flood of my countrymen reached your hospitable shores. I admit we wanted help, and your pity was aroused. But the members of your War Refugees' Committees, consulting more their generous heart than their head, made morally wrong the good they physically did. Further, I dare say, your upper-middle and working classes are quite strangers to each other, and that is one of the reasons why the members of our War Refugees' Committees were absolutely ignorant how to deal properly with the expatriated Belgians.

What was the result? Money was lavishly spent and given without discretion. Men used to hard work got more money than they ever had in their possession, or had dreamed of. They became very soon sluggards. In this state moral feelings are affected, and every day of laziness wrought more havoc amongst them. And what you Englishmen did in splendid generosity and self-sacrifice was considered by the Belgians as an absolute duty, and now they rely fully on it. Poor countrymen, you gave them too much money, and what they wanted was real true moral food, which they can only find in their own selves as a result of hard work.

And still the war is raging, and will last for many months to come, and people here, judging by the facts without looking at the causes, and ignorant also of the psychology of a nation, judge us rather severely now. They think us to be a lazy, indolent folk. The Englishman is tired a bit now of his spoilt child.

And I, with some others, who were courageous from the very first day of the war, are drowned in the mass, and, alas! to my experience, I can assure you that on two occasions lately it was enough for me to mention my nationality in order to see the doors closed to me when I applied for a vacancy.

"I may add that this gentleman has refused any financial help, but up to the present has managed to keep his family of four on a wage of 30s. per week."

Fatalities.—Newcastle-on-Tyne.—An inquest was held on 8th inst. on John Spiller Snell, an electrician, of Heaton, Newcastle-on-Tyne, who had died in the infirmary on November 21st, from injuries caused by an explosion on a vessel in course of construction at a neighbouring shipyard. A fitter named Robert Megson gave evidence as to the explosion, for which he could assign no cause. John Lauder, a fitters' labourer, said Snell, a man called James Nicholson, and others, were engaged on some electric wires at the time of the explosion. After the occurrence he went to look for the men. Nicholson was dead, and Snell was injured. Frederick Alexander Ross, electrical engineer, said he gave instructions for some batteries to be charged. Next morning he found there had been an explosion under the battery hatch, which was blown off. In his opinion the explosion was due to an accumulation of hydrogen gas. There were fans to take away surplus gas, but if there were an accumulation of hydrogen it could be ignited by an electric spark or a light. The most likely explanation was that some one had left off one of the battery tank hatches, and some one had brought means of ignition to the place. Evidence was given that the fans were running shortly before the accident. It was also stated that there might be an accumulation of gas which might have been ignited by a spark due to a loose connection between the cells under the battery cover. A verdict of "Accidental death" was returned, the jury adding that there was no direct evidence as to the cause of the explosion. At the inquest on James Nicholson, an electrician, of Glasgow, a similar verdict was returned, as mentioned by us last week.

Methil.—It is stated that Alex. Martin, aged 16, an apprentice electrician, was killed on Saturday last in the Leven Colliery of the Fife Coal Co., by his arm coming into contact with a live wire.

Trade Union Alliance.—The *Times* states that the Triple Alliance of the Miners' Federation of Great Britain, the National Union of Railwaymen, and the National Transport Workers' Federation was ratified last week at a joint conference of the Executive Committees of the three Unions. The Alliance constitutes the strongest force for combined action in the history of the labour movement. Of the million and a half workers affected by it, the Miners' Federation contributes about 800,000 and the remainder is divided almost equally between the other two bodies. The Alliance was established by unanimous resolution. The following are the principal features:—Matters submitted are to be of a national character, or, in the opinion of the Executive making the request, necessitating combined action. Before the co-operation of the joint organisation is sought the matter in dispute must receive the endorsement of the National Executive of the organisation primarily concerned. Periodical meetings of the three full Executives shall be held at least half-yearly. A consultative Committee of six to be appointed, composed of two members from the Executive Committee of each of the three bodies. Complete autonomy shall be reserved to any one of the three bodies affiliated to take action on its own behalf. Joint action can only be taken when the question at issue has been before the members of the three organisations, and decided by such methods as the constitution of each organisation provides.

Engineers for the Artists Rifles O.T.C.—The officer commanding the 2nd Battalion of the Artists Rifles Officers Training Corps has decided to form a special company, to consist mainly of professional men whose technical experience renders them qualified for appointment as officers to those units or branches of the Army in which knowledge of construction and civil engineering is especially useful in the conditions obtaining in modern war. A large number of men have already been enrolled, but there are still vacancies for civil, mechanical and mining engineers, architects, public works surveyors, and borough engineers, to receive the military training which is essential if the military authorities are to make full use of their professional skill and experience. Professional men having Colonial experience will be particularly welcome. Application for nomination to the corps should be made to the Headquarters, Artists Rifles O.T.C., 7, Duke's Road, Euston Road, W.C.

Social.—On Wednesday of last week nearly 1,500 persons attended the annual whist drive and dance promoted by the Blackpool Corporation Electricity and Tramway Employés' Institute and held at the Blackpool Tower Ballroom. A military band played for dancing. The proceeds, which should be substantial, are to be divided between the Lancashire Military Convalescent Hospital Gymnasium and Concert Hall and the Tramway Employés' Sick and Benevolent Funds.

Dublin Electrical Workers.—The Electrical Trade Union has intimated to public boards that an increase of ½d. per hour and a war bonus of 6d. has been granted to electricians in the city working under the War Office.

Northampton Polytechnic Institute.—The annual prize distribution takes place to-morrow (Saturday) afternoon, at three o'clock.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Torquay E.L. Committee has decided to grant the electrical engineer's application for leave of absence in order to join H.M. Forces, on the conditions applying to the enlistment of officers, it being understood that the assistant electrical engineer, Mr. Keenan, will carry out the duties for the present.

Mr. C. E. Garnett, Darwen's electrical engineer, and Mr. F. J. S. Hosken, manager of the Corporation Tramways, enlisted under the group system on December 9th.

The Newport (Mon.) T.C. is recommended to increase the salary of Mr. H. A. Felton, the electricity works superintendent, from £156 to £166 per annum, and that of Mr. A. H. Clarke, senior engineer-in-charge, from £130 to £140, from April next.

Mr. R. N. Mayne, manager of Redditch electricity works, whose commission in the Bedfordshire Regiment was cancelled by the War Office some time ago owing to the indispensable character of his services in connection with the extension of the undertaking, informed the Council last week that he proposed to renew his application for a commission having regard to the urgent demand for unmarried men under 41 years of age. He asked the Council to release him as early as possible. The matter was referred to the Electric Supply Committee.

Mr. L. Wilde, commercial assistant in the Ilford U.D.C. electricity department, has enlisted as a sapper in No. 4 Company, London Electrical Engineers, and is now stationed at the Fort, Newhaven.

The Hackney Electricity Committee reports that the Borough Electrical Engineer considers that it is imperative that the vacancy caused by the resignation of Mr. H. G. Barraclough, generating engineer, should be at once filled, in view of the large demand on the electricity undertaking. The number of generating engineers required is four, but as at present there are only two on the staff, it has become necessary to engage another at a salary of £3 per week, which is obviously unfair to the engineers on the staff whose maximum salary is below that figure. The Committee is endeavouring to get Mr. A. G. Hilling, assistant distributing engineer, released from H.M. Forces, and, if successful, it is intended to employ him on distributing work generally and to take the place of a generating engineer in case of emergency. If the release of Mr. Hilling is obtained, it would only necessitate the engagement of one man at £3 per week. The Committee recommends that the salaries of Messrs. E. K. Wilkinson (£135), F. D. Osborn (£120), and A. G. Hilling (if released from service with the Colours) (£127 10s.) be increased forthwith to £156 per annum.

The Wolverhampton Town Council on Monday appointed Mr. C. O. Silvers to be general manager and engineer of the Corporation electric tramways, in succession to the late Mr.

W. A. Luntley, at a salary of £350 per annum, rising by annual increments of £50 to £500. During the illness of Mr. Luntley, extending over eight months, Mr. Silvers had acted as deputy-manager. Mr. Martin Griffiths, clerical assistant, was appointed chief assistant to the general manager, and Mr. Hiram Hewitt, rolling-stock superintendent, was appointed assistant engineer.

General.—Mr. Geoffrey Gore Gerdenits, electrical engineer, of Weeping Cross, near Stafford, has changed his name to Geoffrey Gore.

The King has conferred the Territorial Decoration upon the undermentioned officers of the Territorial Force.—*London Electrical Engineers.* Major W. H. Merrett, A.M.I.E.E. *Western Signal Companies* (*Army Troops*). Lieut.-Col. F. A. Cortez-Leigh, M.I.E.E.

Mr. Oliver H. Barker, of Blackheath, will shortly be leaving for Spain, to take up a position in the electrical department of the Rio Tinto Co., Ltd.

Mr. Geoffrey N. Dolby, eldest son of Mr. E. R. Dolby, M.Inst.C.E., senior partner in the firm of Messrs. Dolby and Williamson, consulting engineers, Westminster, enlisted in the Queen's Westminster Rifles in August, 1914, and, after ten and a-half months at the front, has now been gazetted second-lieutenant in the same regiment, to date from November 26th, 1915.

Mr. Alderman Seal, J.P., who was one of the chief promoters of the Sutton Coldfield electricity department 16 years ago, and became its first chairman, piloting the concern through the first nine years of its existence until he saw its financial success was assured, has again become chairman in response to the unanimous desire of the members of the Electricity Committee.

Roll of Honour.—Private E. J. Davis, of the 1st Queen's Royal West Surrey Regiment, who was engaged prior to his enlistment with Messrs. J. & T. Robinson, electricians, Croydon, has been killed in France by a sniper.

Sapper F. Walter, of the 3rd Field Company, Kent Fortress Engineers, who was for 14 years on the staff of the Folkestone Electricity Co., is now reported to have been drowned in the sinking of H.M.S. *Hythe* in the Mediterranean.

Private Ernest Mason, of the 7th North Staffordshire Regiment, who was on the staff of the North Staffordshire Railway electricity department, has been wounded in action at the Dardanelles.

Private A. Cadman, of the Army Service Corps, who was engaged as an electrician at the Chillington Edge Tool Works, of Wolverhampton, and was on similar work in the Army, has been killed in action in France.

Bombardier J. R. Hardyside, of the "D" Battery, 71st Brigade, Royal Field Artillery, has been awarded the Distinguished Conduct Medal and the French Médaille Militaire for bravery in repairing wires under very heavy fire, although suffering from the effects of gas fumes. When war broke out he was engaged at Rugby with Messrs. Willans & Robinson, Ltd.

Rifleman Alfred House, of the King's Royal Rifles, killed in action in France, was, prior to the war, engaged at the Rugby works of the British Thomson-Houston Co., Ltd.

Private H. T. Anderson, of the 8th Battalion The Buffs (East Kent Regiment), who was with Messrs. Siemens Bros., Ltd., of Charlton, S.E., prior to his enlistment in August, 1914, is reported wounded and missing in France.

Private Cyril Ball, of the 1/5th North Staffordshire Regiment, who has been killed in action, was prior to his enlistment in October, 1914, engaged with Messrs. Bullers, Ltd., of Hanley.

Second-Lieutenant H. Lionel Harris, Royal Engineers, second son of the late Mr. H. Graham Harris, died on December 1st from wounds received in action in France. After an engineering course at Rugby he entered the firm of Bramwell and Harris. A few years ago he was employed by W. T. Henley's Co. in the laying of a new cable for the Western Telegraph Co. He came home from Argentina a year ago.

Obituary.—Mr. Wm. Shea.—Mr. Wm. Shea, whose death is announced at the age of 52 years, had been connected with the telephone service for many years, joining the National Telephone Co.'s construction department 32 years ago, and being promoted to Burnley and Blackburn, where he became head clerk. He was subsequently appointed telephone manager for Blackpool and the Fylde, and was later transferred to Southport.

Mr. Frank Iago.—We regret to read of the death of Mr. Frank Iago, late secretary of the Westminster Electric Supply Corporation, Ltd., which occurred on December 8th at the age of 54 years.

NEW COMPANIES REGISTERED.

Newtons (Camborne), Ltd., (142,373).—This company was registered on December 10th, with a capital of £5,000 in £1 shares, to carry on the business of scientific and mathematical instrument makers, opticians, mechanical, electrical, civil and hydraulic engineers, gun makers and fitters, tool makers, founders, metal workers, etc. The subscribers (with one share each) are: S. Staples, 34, Vicarage Road, Neasden, N.W., clerk; A. W. Kelly, 13, Clancarty Road, Fulham, S.W., clerk. Private company. The number of directors is not to be less than two or more than five; the first are S. Staples and A. W. Kelly (provisional directors). Qualification (except first directors), £100. Registered office: 47, Bishopsgate, E.C.

Arcorundum Abrasives, Ltd. (142,352).—This company was registered on December 9th, with a capital of £2,000 in £1 shares, to carry on the business of manufacturers of abrasive materials, engineers, founders, smiths, machinists, electricians, manufacturers and workers of and dealers in electricity and electrical motive power, etc., and to adopt an agreement with W. R. Hague. The subscribers (with 100 shares each) are: F. E. Tidswell, 51, Holloway Road, N., emery manufacturer; W. R. Hague, 42, Newport Road, Stafford, civil engineer; G. Millington, Elmwood, Rowley Park, Stafford, engineer. Private company. The number of directors is not to be less than two or more than three; the first are F. E. Tidswell, W. R. Hague, and G. J. R. Millington. Qualification, £100. Solicitors: Greatrex, Warner & Beswick, Bank Chambers, Stafford. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

O'Neil's Recorder Syndicate, Ltd. (142,362).—This company was registered on December 9th, with a capital of £2,000 in £1 shares, to acquire certain patents for inventions in relation to signalling for use on vessels, and recording the course steered by vessels at sea, and to carry on the business of mechanical, electrical, hydraulic and general engineers and contractors, etc. The subscribers (with one share each) are: C. A. Beldam, 1-2, Gracechurch Street, E.C., merchant; R. S. O'Neil, 16, Lee Road, Blackheath, S.E., engineer. Private company. C. A. Beldam and R. S. O'Neil are governing directors, and may retain office while holding between them half the issued share capital. Solicitors: Wansey, Stammers & Co., 28, Moorgate Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Naylorgraph, Ltd.—Debenture, dated November 13th, 1915, to secure £400, charged on the company's undertaking and property, present and future. Holder: J. M. Hunt, Fairlawn, Park Road, Southborough.

Chepstow Electric Lighting and Power Co., Ltd. (70,646).—Capital, £10,000 in £1 shares. Return dated October 23rd, 1915. 5,510 shares taken up; £1,537 paid, leaving £68 in arrears; £3,905 considered as paid. Mortgages and charges: £1,000.

Tramways Light and Power Co., Ltd.—Trust deed, dated November 15th, 1915 (supplemental to trust deed of February 26th, 1914), securing £100,000 5 per cent. debenture stock, charged on certain shares, debenture stock, and debenture scrip specified in the principal deed, and the company's general assets. Trustees: Trustees, Executors & Securities Insurance Corporation, Ltd.

Colne Valley Electric Supply Co., Ltd.—Debenture, dated December 2nd, 1915, charged on the company's undertaking and property, present and future, including uncalled capital, to secure all moneys due or to become due from company to Barclay & Co., Ltd., 54, Lombard Street, E.C.

CITY NOTES.

The Oerlikon Machine Works.

The Maschinenfabrik Oerlikon, of Oerlikon, near Zurich, reports that a diminution took place in the net profits in 1914-15 owing to the impossibility of maintaining normal working through the difficulties experienced in obtaining raw materials, and to the losses due to the fall in exchange, which however, had been written off; whilst at the same time manufacturing was disturbed by the constant changes in the number and efficiency of the officials and workers available in consequence of the alterations in the military requisitions, each change having necessitated a reorganisation in the shops and offices. The orders received gradually increased during the year until the stock had reached the normal level in nearly all departments, but the obstacles in question, together with the troubles incidental to procuring export or transit permits and the lack of transport facilities at times, prevented advantage being taken of the situation.

The department for general electrical machinery and transformers was well occupied on the declaration of war, when the undertaking was increasingly engaged for the home market. As a result of the scarcity of petroleum, benzine, and crude oil, it was necessary for users of light and power to substitute electricity, and the demand for motors and transformers of low powers consequently advanced. The report then refers to the advent in England, France, and Spain of American competitors who, it states, sought to secure the markets by the offer of low prices and exceptionally short periods for delivery. Their success, however, did not seem to be great, because customers entertained some doubts regarding the particular types of construction, and apprehended difficulties in connection with the subsequent provision of spare parts and the execution of repairs.

The railway department confirmed the successful inauguration of working in connection with the deliveries for the London & North-Western Railway Co., the question concerning an initial supply of the electrical equipment of 43 three-coach trains with motor coaches, each of 1,000 H.P. The control was effected by an automatic multiple remote controller on a new system devised by the company. The favourable results of the starting of the service had induced the railway company to place a repeat order of a similar extent. After exhaustive preliminary trials, the deliveries of the electrical equipment of three-phase locomotives of a rating of 3,000 H.P., with four different grades of speed, were being carried out for the Italian State railways. The locomotives for the Lotschberg railway continued to answer the purpose,

the large commutator motors in particular showing exceptionally low wear and tear. The results indicated the success of the single-phase alternating current system for heavy traction, which would probably put an end to doubts and experiments as to the system suitable for the Swiss railways. It is stated that the company undertook the supply of fuse components for the Swiss military authorities, but the delivery of war materials and munitions to all belligerent States was refused.

The accounts show gross profits amounting to £120,000 for 1914-15, as compared with £137,000 in the preceding year. After meeting general expenses, interest charges, and depreciation (£34,000, as against £39,000), the net profits and balance forward are returned at £35,000, as contrasted with £48,000 in 1913-14. It is intended to pay a dividend of 6 per cent., being the same rate as in the previous year, on share capital of £320,000.

Adelaide Electric Supply Co., Ltd.

THE directors report that during the year ended August 31st, 1915, there was a further capital expenditure of £79,198, making £829,622, less £12,074 written off. The capital necessary to keep pace with the continued growth of the company's business has been provided for by the issue during the year of the balance of 10,365 preference shares, and of a further £25,000 debenture stock. In pursuance of authority received at the meeting of October last, the directors recently applied to H.M. Treasury for permission to issue a further 20,000 ordinary shares, and to offer the same at a premium of 30s. per share to the holders of the existing ordinary shares in the proportion of 4 new shares to 10 old. Permission having been granted on the understanding that the issue be made only to shareholders residing in Australia, a circular has been issued to the latter offering them their *pro-rata* allotments of the new shares. 2,142 new consumers were connected to the mains during the year, bringing up the total number connected to 15,334, an increase of 16 per cent., as compared with the preceding year. The power supply has increased by 12 per cent., the electric motors now connected being equivalent to 8,236 H.P., while the total connections, including lamps, motors, heating, and other apparatus, have increased by 14 per cent.; the total units sold by 5 per cent.; and the gross revenue by 7 per cent. The profit and loss account shows that the gross revenue amounted to £119,897, an increase of 7 per cent. After payment of debenture interest, and management and general expenses in London and Adelaide, and after allocating £9,129 to debenture stock service fund, there remains a credit balance of £42,068, plus £10,815 brought forward, making £52,883. After paying dividends of 6 per cent. on the preference and 10 per cent. on the ordinary shares, a bonus of 2 per cent. on the latter is recommended, carrying forward £7,920.

Date.	Number of consumers.	Lighting in KW.	Motors in rated H.P.	Total connections in KW.	Total units sold.
Aug., 1913	11,351	7,752	6,270	14,022	5,446,488
Aug., 1914	13,192	10,107	7,347	17,454	6,740,991
Aug., 1915	15,334	11,744	8,236	19,980	7,055,015

The business of the company continues to make good progress notwithstanding the adverse influences of war and the recent drought, the demand for electric light and power in the extensive area served by the company being maintained satisfactorily in the circumstances.

Annual meeting: December 21st.

Melbourne Electric Supply Co., Ltd.

IN their report for the year ended August 31st, 1915, the directors state that in pursuance of the resolutions passed by the shareholders at the last annual general meeting, and with the permission of H.M. Treasury, the directors issued a circular on February 1st last, offering 75,000 ordinary shares of £1 each at par to the holders of the existing £300,000 consolidated ordinary stock, payable on March 1st, 1915. The whole of these shares were taken up, and subsequently converted into consolidated ordinary stock.

To provide for essential capital expenditure and thereby to enable the company to fulfil its statutory obligations, the directors recently applied to H.M. Treasury for permission to issue the balance of 125,000 ordinary shares of £1 each, and to offer the same at par to the holders of the existing £375,000 consolidated ordinary stock as nearly as possible *pro-rata* (*i.e.*, 1 in 3). Permission having been granted subject to an issue being made in Australia and to Australian stockholders only, a circular will shortly be issued to the latter offering them their proportion on the above basis. The rights of stockholders on the London register to their *pro-rata* allotments are reserved for issue to them at a future date when Treasury permission is granted or has ceased to be necessary. Certificates to this effect will be issued to stockholders on the London register.

£5,000, as provided for in last year's accounts, has been applied during the year in writing off certain items in the Melbourne account. The capital expenditure at Melbourne was £94,192, and at Geelong £9,827, for the year. The balance of expenditure stands at £1,111,633. 4,125 new consumers were connected to the mains during the year, bringing up the total to 23,191, an increase of 22 per cent. The power supply has increased by 41 per cent., the electric motors now connected being equivalent to 17,609 H.P.; the total connections, including lamps, motors, heating, and other apparatus, have increased by 26 per cent.; the total units sold by 25 per cent.; and the gross revenue by 20 per cent. The profit and loss account shows that the gross profit derived from the Melbourne and Geelong undertakings amounted to £117,677, as compared with £104,340, an increase of 13 per cent. After payment of debenture interest, and management and general expenses at the London head office, and after making the following allocations, viz.:—To first debenture stock sinking fund £2,500, consolidated debenture stock sinking fund £2,690, income certificate service fund £1,800, general reserve (raising it to £70,000) £5,000, and writing off the balance of cost of increase and issue of capital (including Government Stamp Duty) £517, there remains a credit balance of £77,208, plus £7,820 brought forward, making a total credit balance of £85,028. Deducting from this the dividend on the 7 per cent. first cumulative preference shares for the half-year ended February 28th, 1915, and the interim dividend of 5 per cent., free of income-tax, on the consolidated ordinary stock paid on June 1st, 1915, there remains £64,778. A dividend of 7 per cent. on the preference shares and one of 10 per cent. for the year on the ordinary stock leaves £40,778 to carry forward.

Date.	Number of consumers.	Lighting in KW.	Motors in rated H.P.	Total connections in KW.	Total units sold.	Gross profit.
Melbourne—						
Aug. 31, 1913	13,571	12,189	9,581	21,720	9,740,174	£68,581
Aug. 31, 1914	19,066	16,816	12,444	28,760	13,963,400	£93,202
Aug. 31, 1915	23,191	19,932	17,609	37,541	17,486,300	£107,515
Geelong—						
(including trams)						
Aug. 31, 1913	1,456	1,784	1,846	3,580	1,034,052	£8,511
Aug. 31, 1914	1,939	2,051	2,085	4,133	1,252,153	£11,137
Aug. 31, 1915	2,290	2,306	2,155	4,461	1,270,516	£10,162

The business of the company has been well maintained notwithstanding the adverse influences of war and the recent drought. There is an increasing demand for light and power from all classes of the company's consumers, including numerous firms in Melbourne and Geelong engaged in the manufacture of war munitions and requisites. The directors record the death of Mr. J. F. Albright, who had been a director since the formation of the company in 1899.

Annual meeting: December 22nd.

India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.

THE accounts for the year ended September 30th, 1915, show, after provision for doubtful debts, a net profit of £80,404. Adding £1,034 brought forward, deducting £12,500, the dividend on the preference shares paid in January and July and accrued to September 30th, and £12,500, the interim dividend on the ordinary shares paid in July, there remains a disposable balance of £56,438, which, after providing for the proposed dividend on the ordinary shares, will leave £18,938 to carry forward. The directors recommend that the payment of the half-yearly dividend of 5s. per share, or at the rate of 5 per cent. per annum, be made to the preference shareholders and that a dividend of 15s. per share, free of income-tax, amounting to £37,500, making with the interim dividend paid in July a total payment of 10 per cent. for the year, be paid to the holders of ordinary shares. The directors are pleased to be able to make such a satisfactory report in spite of the constantly increasing cost of coal, labour and raw material, and the dislocation of transport. Although the works at Persan remained closed till after the beginning of the financial year, and labour has been exceedingly scarce in France owing to the war, it is a matter of congratulation that the loss on the previous year has been converted into a profit in the year under consideration. The branches abroad have also shown much better results. The foregoing statement proves that the directors were justified in paying an interim dividend in July last. The directors cannot now estimate the amount of tax on profits which may become payable under the Finance Act when it becomes law on account of this year's trading; but the carry forward has been considerably increased. The *Dacia* has had a fair share of employment, and the *Silvertown* was chartered for a short period during the year. The works and machinery at Silvertown have been efficiently maintained. The directors regret to report the death, on September 2nd last, of Mr. Matthew Hamilton Gray, who had been associated for so many years with the work of the submarine department at Silvertown, and at the time of his death was consulting engineer to the company in these matters.

Meeting: December 22nd.

Costa Rica Electric Light and Traction Co., Ltd.

THE accounts for the year ended 30th June, 1915, show that the net earnings in Costa Rica, after charging all expenses incurred, amount to £21,662, a decrease of £4,689 (mainly due to the adverse exchange). The net surplus profit is £3,833, which the directors propose to carry to the credit of "discount and commission on debenture issue" account. The power plant at El Brasil has worked well throughout the year. some trouble, which was experienced in times of floods, has been eliminated by the installation of larger sluice gates. Electrical cooking has continued to develop during the past year, and the revenue from this source has been satisfactory. In common with other countries, Costa Rica is suffering considerably from the European War, and the business of this company has, as anticipated in last year's report, suffered considerably from the interruption of exports and the general upset of trade relations. In view of this, and of the serious loss entailed by the high exchange, the net result of this company's operations

for the year must be considered satisfactory. The management of the business in Costa Rica continues to give the directors every satisfaction. During the year the gold premium has averaged 150 per cent., as against 112 per cent. for the previous year.

Annual meeting:- December 22nd.

German Electrical Companies.

The liquidator of the *Helios, Elektrizitats Gesellschaft, of Cologne*, has not yet been able to wind up the proceedings. The report for the year ended June 30th, 1915, shows no change in the investments held or in the deficit of £419,000 brought forward from 1913-14.

The Norddeutsche Kabelwerke, A.G., of Neu-kölln, which company was first formed last March, and took over a private cable manufacturing concern of the same name, proposes to pay a dividend of 10 per cent. for the financial year on a share capital of £75,000. A large interest in the undertaking is held by the Mix & Genest Co.

The Deutsche Gasgluhlicht A.G., of Berlin, reports net profits, after placing £18,000 to depreciation in 1914-15, as against £24,000 in 1913-14, amounting to £169,000, as compared with £224,000, exclusive of the balance of £101,000 brought forward from the previous year. A dividend of 25 per cent. has been declared on the ordinary share capital of £495,000, as in 1913-14, whilst the preference share capital has been redeemed to the extent of £165,000 out of banking credit, which has thereby, together with £400,000 subscribed to war loans, been reduced to £385,000. The report contained no statement as to the electrical department, nor was any reference made to it at the general meeting.

The report of the *Telephon Fabrik, vorm. Berliner, of Hanover*, states that a particularly favourable development took place in the year ended with June 30th, 1915, as the war afforded the possibility of fully utilising the departments, and thereby earning large profits. Large orders were on hand for the Government, and the turnover was much greater than in the preceding year, whilst the net profits were considerably greater, notwithstanding the higher prices for raw materials and the increased rates of wages. It was also possible to make substantially greater allocations for depreciation and the reserve fund. The net profits, which were recorded in this journal on December 3rd, have permitted of the payment of a dividend of 18 per cent., as against 10 per cent. in 1913-14. It is added that the new financial year commenced with a large stock of orders on the books.

The Bayerische Stickstoff Werke, A.G., of Munich, which company was entrusted by the Government with the construction and working of two cyanamide manufacturing works, apart from its own plant of the same kind, reports that the sales of stocks and products were buoyant in 1914-15, when new plant was installed to increase the capacity. The sum set aside for depreciation was £33,000, as contrasted with £27,000 in 1913-14, leaving net profits of £57,000 and £32,000 in the two years respectively on an ordinary share capital of £400,000. A dividend at the rate of 12 per cent. has been declared, as compared with 8 per cent. in the previous year, and it has been decided to raise the share capital to £600,000, partly for the purpose of developing the power of the Alz at Tachertingen. It is stated that the two new works for the Government have now been completed, the company having established a special department for this purpose and a branch in Berlin.

Venezuela Telephone and Electrical Appliances Co., Ltd.—The report for the year ended June, 1915, shows a profit of £17,644, plus £10,433 brought forward. After providing for interest on prior lien, first and second debentures, and for payment of income-tax, there remains a balance of £20,401, out of which it is proposed to pay a dividend of 30 per cent., amounting to £2,580 (less income-tax) cumulative preference shares, thus discharging arrears of dividend to December 31st, 1906, to place the sum of £6,000 to reserve for renewals and depreciation, and to carry forward the balance of £11,821. £6,191 has been spent on capital account during the year.—*Financial Times.*

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The directors announce an interim dividend of 3 per cent. (being at the rate of 6 per cent. per annum) on account of the dividend accrued on the 6 per cent. cumulative preference shares.

Ruthin Electric Supply Co., Ltd.—The first annual meeting was held on November 25th. The works were opened last February. The number of consumers connected exceeds the promoters' expectations. The directors were re-elected.

Canadian General Electric Co., Ltd.—A quarterly dividend of 1¾ per cent. on the common stock for the three months ending December 31st is announced.

Blackpool, St. Anne's and Lytham Tramways Co., Ltd.—The accounts for the year ended October 31st, after providing £7,500 for interest on debenture stock and £1,500 for sinking fund, show a debit balance of £42,235 which is to be carried forward.

Eastern Telegraph Co., Ltd.—The directors announce a dividend at the rate of 3½ per cent. per annum, less income-tax, on the preference stock for the past quarter, and the third quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of income-tax.

J. G. White & Co., Ltd.—No interim dividend is to be paid on the preference shares.

Marconi's Wireless Telegraph Co., Ltd.—An interim dividend of 5 per cent. on the ordinary shares is announced, also a dividend of 7 per cent. on the preference shares.

Marconi International Marine Communication Co., Ltd.—Interim dividend of 5 per cent., less income-tax.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets all round are very quiet. The larger capitalists have been putting substantial amounts into the French Loan, the subscription lists for which closed on Wednesday in this week. Quantities of the British Treasury bills are being taken by the banks and other financial institutions, the funds thus employed not passing through the Stock Exchange at all. The Government scheme for buying American railroad bonds is another factor making for quietude in the markets, and smaller sums are being reserved for investment in our own War Loan which is to come. With regard to the last, it is said now that its advent may be postponed until early spring; and this consideration has done something to help the price of Consols. The news from the various war fronts remains uncertain enough to check any speculative disposition on the part of the public; nor has anything sufficiently exciting come of late from the Latin-Canadian countries to galvanise the different markets connected with their securities.

Charing Cross City preference relapsed 5s. to 3, and the 4 per cent. debenture stock at 78 is 2 points down. St. James' fell ¼ and South Londons ½, to 6½ and 2¾ respectively. South Metropolitan ordinary have been changing hands in the neighbourhood of 13s. Business in this section is meagre. An apt illustration of the prevailing state of affairs is to be seen in the fact that although St. James', as already mentioned, are down ¼ to 6¼, no shares have changed hands in the Stock Exchange since the beginning of June, the last recorded bargain having been at 7 5/32.

Bournemouth and Poole ordinary have been dealt in within the last week at 9¼. There is a little business doing in County of London ordinary and preference, the prices in each case being 10, with the preference slightly better than the ordinary. Yet still the difficulty of obtaining shares is noticeable in certain cases. A buyer of Melbourne Electric preference has been bidding 5½ without success, although the shares last changed hands on this basis early in July.

Dividend estimates are being cast by those interested in the electric lighting market, and a good deal of curiosity is felt as to how the various companies will emerge from the present half-year. Speaking generally, it is expected that the West End undertakings will be found to have fared badly. The City Company may be expected to show comparatively good results, having regard to the circumstances of the times. The County of London, with its extensive ramifications and its large circle of customers using current for power, should be in a better position than most of the others.

If there should happen to be any supply companies in the group which have undertaken big contracts without the saving protection of a coal clause, the absence of such a safeguard will probably make itself felt severely in the accounts. Pending the dividend announcements and the issue of the reports, it is superfluous to do more than re-echo these generalised ideas current in Stock Exchange circles.

British Aluminium ordinary shares, which had a sharp rise last week, have gone back a shilling, but retain a good deal of elasticity and market animation. The company, as already mentioned, is said to be doing exceedingly well, and there is a talk of the previous 5 per cent. dividend being doubled. The 6 per cent. preference shares have drooped to 18s., at which the return is 6¾ per cent. on the money. Castner-Kellners are changing hands pretty freely on the basis of 60s. Edison & Swan 4 per cent. debenture has risen 5 points to 62, and business was marked at this price at the end of last week. General Electric preference have been done at 9 11/16, and a bargain was recorded in the ordinary shares a few days ago at £10 9s. 3d. per share.

India-Rubber, Gutta-Percha & Telegraph Works ordinary rose 25s. to 9 upon an excellent report, which shows that the poor results of 1914 were the temporary matter which the board then anticipated. Last year, it may be recalled, the reserve fund was raided to the extent of £50,000 in order to pay the preference dividend, and 5 per cent. on the ordinary. For the year just finished, the company's profit came to £80,400, against a loss of £19,000 in the preceding twelvemonth. The carry-forward is raised from the bagatelle of £1,000 to £18,900; and the dividend on the ordinary shares reverts to 10 per cent., free of tax. It is one of the most satisfactory reports which we have seen for a long time, and shareholders are to be congratulated upon the achievement.

The feature of the week in markets devoted to electrical issues is a sharp rise in the various issues of the British Columbia Electric Railway. We restored four of the company's stocks to our price lists a few weeks ago, on the assumption that affairs in the Dominion and Farther West were sufficiently promising to justify the anticipation that more interest was going to be taken in the stocks and shares connected with them. The deferred and the preference are both up 7 points, the preferred gained 3, and the 4½ per cent. debenture stock went up 2. Once again the monotonous statement has to be repeated that there is very little stock to be obtained, and buyers want the offer.

The Adelaide Supply Co. has had a fine year, and the ordinary dividend of 10 per cent. is supplemented with a bonus of 2 per cent. More capital is required, and the Treasury's sanction has been obtained to an issue of 20,000 ordinary shares, at 30s. premium, on the understanding that the shares shall be offered only to proprietors in Australia.

British Electric Traction preference were sold a few days ago at 73, the 7 per cent. non-cumulative and the 6 per cent. preferred ordinary changing hands at 46 and 15 respectively, while the deferred was done at 10 and 8¼. London & Suburban Traction ordinary have dropped back to 2s. 6d., and the 5 per cent. preference can be obtained at a shade under half-a-sovereign. The last recorded bargain in London United Tramways 4 per cent. debenture stock was at 51.

The Anglo-Argentine Tramways group keeps very steady, most of the business nowadays being in the 5 per cent. debenture, on the basis of 81. Brazil Tractions have gone back to 53½, more in sympathy with the dullness of other markets round the House than from any particular apprehension on account of the decline in the rate of the Rio exchange. Mexico Trams and Mexican Light & Power descriptions are a trifle uncertain. The first mortgage bonds of the latter company are a point lower at 48. Business in the shares occasionally takes place about 42, but the absence of news from Mexico is a good reason for the lack of business now apparent in this section.

Home Railway Steam stocks tend to sag, in spite of the near approach of the dividend distribution. With the uncertainty surrounding the Government attitude in the matter of dividends, people refuse to buy Home Railway stocks, except by occasional spasms. But the electrical group is firm, with Central London 1½ better at 72½. Recently some reviving attention has been paid to East London ordinary stock, where buyers have been giving about £4. Metropolitan Consolidated ordinary, deferred dividend, stock was done the other day at 15¾, and the Surplus Lands stock at 15½. Districts are better at 15¼. Underground Incomes lost a small fraction.

There is a rumour to the effect that the Treasury intends to remove all minimum prices, from stocks affected by their previous regulation, on January 1st next. Meanwhile, there is a fair amount of business passing in Metropolitan District 6 per cent. debenture stock, this being one of the securities not "protected" by the Treasury restriction. The stock carries 3 per cent. dividend, payable at the end of the year; it can be bought at 114, and at this price the yield on the money comes to £6 2s. 10d., allowing for inclusion of the interest.

Telegraphs present a firm front as a whole, with small advances in Anglo-American preferred and Eastern Extensions. River Plate preference are ¼ lower, and Oriental Telephones have eased off. Marconis are a very dry market at present, the price having hardly moved for about a month. Henleys are in demand, with a rise of ¼ to 13, though the preference lost a similar amount at 4½. British Insulated preference have also weakened, while the ordinary at 10½ are ⅜ to the good. It would seem that holders of preference shares are exchanging them for ordinary—at all events, in this particular department. Rubber shares are well maintained with the price of the product, which keeps about 3s. 7d. per lb. In the leading rubber shares business is still reasonably active, but the recent rush to buy is over for the time being.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Blackpool-Fleetw'd	Sept. 25	7,085	+2,182	38	93,886	— 458	8	..
Bristol	Nov. 26	88,599	+7,081	47	451,173	+45,649	30·5	..
Cork	„ 25	1,798	— 3	47	23,639	+ 25	54·25	..
Dublin	„ 26	22,522	+ 257	47	287,405	+10,693	9·89	..
Hastings	„ 25	2,930	- 106	..	..	— 166	19·3	..
Lancashire United	„ 24	6,947	+ 476	47	81,852	+ 5,145	42	..
Llandudno-Col. Bay	„ 26	761	+ 150	48	17,294	+ 1,787	6·5	..
Tyneside	„ 24	2,000	— 98	21	13,000	— 531	11	..
Anglo-Argentine ..	„ 25	310,986	+2,480	7	2,397,086	—134,417	..	..
Auckland	„ 19	20,910	1,519	20.2	101,036	— 482	25·42	1·06
Calcutta	„ 27	16,841	+ 698	..	..	— 3,238	..	..
Kalgoorlie, W.A. ..	Sept.	2,937	..	39	25,116	..	..	..
Madras	Sept. 30	1,887	- 263	39	35,204	+ 721	..	..
Montevideo ..	Nov.	28,407	+1,326	4	28,407	+ 1,326	..	..
Dublin-Lucan Rly.	Nov. 26	556	+ 12	21	3,275	+ 90	7	..

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Dec. 14, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	3	— ¼	7 10 0
do. 4 Deb.	4	73	— 2	5 9 7
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	83	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3½	—	6 0 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6½	— ½	8 0 0
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅝	— ⅛	7 5 6
South Metropolitan Pref.	7	1 1/16	—	6 14 0
Westminster Ordinary	9	6½	—	6 18 6
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones				
Anglo-Am. Tel. Pref.	6	101	+ ⅛	5 19 0
do. Def.	1½	x2⅝	—	6 11 3
Chile Telephone	8	6⅜	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12⅜	+ ⅛	*6 9 3
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	*6 4 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 9 2
do. Pref.	6	10⅝	—	5 12 6
Gt. Northern Tel.	22	83⅜	—	6 11 4
Indo-European	13	48 xd	—	6 15 4
Marconi	10	1⅞	—	5 6 8
New York Tel. 4½	4½	101	—	4 9 1
Oriental Telephone Ord.	10	1⅞	— 1/16	5 6 8
do. Pref.	6	6	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	*7 12 5
do. Pref.	5	4⅜	— ⅛	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	—	*6 7 0
do. 4 Deb.	4	80	—	5 0 0
Home Rails				
Central London, Ord. Assented	4	72½	+1½	5 10 6
Metropolitan	1½	24½	—	5 2 0
do. District	Nil	15½	+ ½	Nil
Underground Electric Ordinary	Nil	1⅜	— 1/16	Nil
do. do. "A"	Nil	5 9	—	Nil
do. do. Income	6	77	— ½	*8 17 6
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95 xd	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	8½	—	7 17 2
do. 4 Deb.	4	76	—	5 5 3
do. 4½ Deb.	4½	76	—	5 18 5
do. 5 Deb.	5	81	—	6 4 0
Brazil Tractions	3½	53½	— 2½	6 10 10
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—2	5 3 0
British Columbia Elec. Rly. Pfce.	5	60	+7	8 6 8
do. do. Preferred	—	40	+3	Nil
do. do. Deferred	—	40	+7	Nil
do. do. Deb.	4½	64	+2	6 12 10
Mexico Trams	Nil	42	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	44	—	Nil
Mexican Light Common	Nil	30	—	Nil
do. Pref.	Nil	42	—	Nil
do. 1st Bonds	—	48	—1	—
Manufacturing Companies.				
Babcock & Wilcox	14	2⅝	—	6 1 9
British Aluminium Ord.	5	22/6	—1/-	4 9 0
do. Pref.	6	18/-	—3d.	6 13 4
British Insulated Ord.	15	10½	+ ⅜	7 2 10
do. Pref.	6	5⅜	— ½	5 11 7
British Westinghouse Pref.	7½	88/6	—	7 16 0
do. 4 Deb.	4	70	—	5 14 4
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	10½	—	7 2 10
do. 5 Pref.	5	4½	— ½	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	8	+1/-	6 13 4
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	62	+5	6 9 1
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9⅜	—	6 3 1
Henley	20	13	+ ¼	*8 15 9
do. 4½ Pref.	4½	4½	— ¼	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9	+1½	*11 8 2
Telegraph Con.	20	31½	—	*8 1 0

*Allowance made for dividends being paid free of income-tax.

International Light and Power Co., Ltd.—According to a financial paper, the quarterly dividends on the preference shares are deferred for the present.

ELECTRICAL ACCIDENTS IN MINES.

(*Concluded from page 762.*)

In one of the underground accidents a coal-cutter machine man worked a 25-H.P. Hurd bar cutter driven by a medium pressure (about 440 volts) squirrel-cage three-phase motor. The deceased was the chargeman.

At the time of the accident the machine was about midway between the gates, and it was stopped so that deceased might lay a set of rails. When working, the machine travelled towards the gate-end box, to which it was connected by a trailing cable some 80 yards in length, containing three vulcanised rubber-covered leads each 0.035 sq. in. section, and an insulated earth conductor of 7/20 copper wire (0.007 in. section), the whole four wires being twisted round each other and packed with some hemp inside a leather cover stitched together by a longitudinal seam.

It appears that when deceased was fitting a rail to a steel sleeper just in front of the machine he received the shock which killed him. On hearing a shout, his mate went round by the gate and switched the current off the cable at the gate-end box, and then discovered deceased lying full length on the trailing cable with his legs slightly pulled up, his head being close to the front wheel of the machine. The loose rail he was laying was in his left hand and a hammer in his right.

At the inquest an assistant electrician spoke of having examined the trailing cable about ten hours before by passing his hand along the leather covering. By such an examination he could not judge more than that the covering was right. As regards the continuity of the earth wire, this had been tested and found all right about a month before. After the accident the trailing cable was opened out and found to be in bad condition, there being two faulty places on the conductors and two breaks in the earth wire. Under these circumstances the death of deceased was easily accounted for.

Owing to the way in which the cable was constructed, Mr. Charles D. Mottram, H.M. Inspector of Mines, who visited the mine to investigate the accident, could not definitely say where the cable was faulty until the leather cover had been stripped off. As regards the broken earth wire, only a test would indicate this defect. The cable had been in use five years, and it could hardly be expected to be in other than a well-worn condition. That the earth wire was found to be broken was no doubt due to the constant coiling and uncoiling of the cable under working conditions.

It was evident that a month was too long to trust to the continuity of any earth conductor, and Mr. Nelson, H.M. Electrical Inspector, who also visited the colliery and attended the inquest, expressed the opinion that earth conductors of trailing cables should be tested for continuity on each day before the cable is put to use.

As the earth conductor was of less cross-section than .022 sq. in., the minimum provided by General Regulation 125 (*b*), proceedings were taken against the agent of the colliery for a violation of the regulation referred to. The facts were not in dispute. The use of an earth conductor which failed to comply with the regulations was proved, but it was argued in defence that as the trailing cable, which included the earth conductor, had been in use before the 1st June, 1911, the company was within its rights, under General Regulation 137 (*b*), in continuing the earth conductor in use, even though the coal-cutter had been installed since the 1st June, 1911.

The Bench held that the defence was right, and dismissed the case without, however, giving the defendant his costs.

In the other accident, an assistant electrician was killed whilst splicing an electric cable carrying 550 volts pressure in a gateway. The deceased had, before proceeding to work, written with chalk on the junction switch-box cover: "Don't touch this switch, N. Lumb." The current was subsequently switched on by some person unknown. Coal-cutters driven electrically were about to be used, but the machine chargeman swore on oath at the inquest that, while it was his custom to switch on the current, if not already on, when going inbye, he did not do so on the occasion of the accident, as the current was already on when he passed in to work.

This accident, which was an avoidable one, was due, apparently, to the carelessness of some person not reading the notice on the switch. The management have since arranged to lock the switch-lever while repairs are going on between the switch and the coal face. In such cases the key should be in the possession of the individual working on the dead conductors. This appears to be the practice in working on high and medium pressure mains on the surface, and it is obviously as necessary underground. Clearly no person's life should depend upon a chalked message being observed and acted upon.

In the Lancashire and North Wales Division there were no fatal accidents, but three persons were slightly burnt.

In the South Wales Division there was one fatal accident below ground, and six non-fatal accidents in which seven persons were injured. As regards the fatal accident, an assistant electrician received a fatal shock while attempting to replace the cover of a switch-box without previously having switched off the current. The pressure was 500 volts. As regards the non-fatal accidents, the Inspector reports these "were caused by irregular or improper manipulation of electrical plant, and one by a faulty connection." Why will workmen not remember they are working with a live and dangerous force, which is not to be treated with contempt?

In the Midland and Southern Division there were two non-fatal accidents below ground and three above ground. Of the former, one occurred to an electrician who was changing a fuse. Finding that the fuse he had did not fit, in order to allow the motor to work, he attempted to couple up a short length of insulated wire to act temporarily. While doing so he apparently allowed one end of the wire to touch a live part after the other end had been fixed. The result was a short circuit, which caused a flash which burned his face slightly. He was subsequently fined by the manager for contravention of General Regulation 131 (*g*). The second accident was very similar. An assistant electrician was making an examination for the purpose of discovering the cause of the stoppage of an electrical coal-cutter. When pulling out a fuse, a piece of wire protruding from the bridge made a contact which caused some sparking, which slightly burned his right hand and forearm. Had the current been cut off as provided for by General Regulation 128 (*b*), the accident would have been prevented.

Of the surface accidents, one occurred to a power-house attendant who was replacing a fuse which had blown. A liquid starting switch controlling a 16-H.P. motor (500 volts) had not been taken out. In replacing the fuse, the attendant brought the contacts of the switch, which was of the ordinary double-pole tandem quick-break type, together slowly, and then opened it. The result was an arc, which burned him superficially on the hand and wrist.

In the second case, two electricians had been changing the armature in a motor, and in coupling up again, one of them in error failed to connect one of the supply cables on to the field, with the result that the no-volt release got the full load without any resistance. The no-volt release coil insulation was completely destroyed inside the starting switch box. Without knowing what had occurred, the assistant electrician put in the switch, and an explosion immediately resulted, blowing off the switch-box cover,

which struck him on the stomach and slightly injured him.

The third accident occurred in the same power-house and to the same attendant as was injured in the first accident. He was actuating a change-over switch on a lighting panel, and appears to have manipulated it improperly. The result was an arc, which slightly burned him on the forehead and eyes. The switch was of an old type, but had been in use for some 14 years. It has since been replaced by one of modern type.

These accidents are interesting as showing that in nearly every case they could easily have been avoided with a little attention and care. It is surprising that much of the apparatus was poorly constructed and faulty in spite of all the Home Office regulations. We sincerely trust that all colliery managers will benefit by these records, and have their own installations put into thorough order.

OUR TRADING OPPORTUNITIES THROUGHOUT THE WORLD.

(*Continued from page* 764.)

The Trade of New Zealand.

In his final report as H.M. Trade Commissioner for New Zealand, Mr. W. G. Wickham urges manufacturers to educate their prospective customer, whilst studying his particular requirements, into appreciating the superior value of British goods. At the same time Mr. Wickham points to the necessity for lowering selling prices to a more competitive level, and he makes some suggestions for effecting this by improved shipping arrangements and better methods of distribution. His remarks are summarised below. He evidently takes the view that more orders would pass to the Mother Country if the manufacturing exporter got into closer touch with the purchaser, and by this means terminated, or at least curtailed, the system by which the New Zealand importer indents on buying agents and shipping agents for the goods required. Mr. Wickham's experience from investigating complaints is that many mistakes for which manufacturers are blamed are due to these agents, who work in grooves, and are just as ready to place orders in Continental hands as British. The statements that this and that line cannot be got in England, and that manufacturers will not do this or that, or modify something else, nearly always proceed from them. After the outbreak of war, Mr. Wickham circularised the leading New Zealand importers suggesting that they should instruct their London buyers to consult at the Board of Trade the lists of manufacturers who were prepared to supply goods previously furnished by Germany and Austria. He found that some importers would not be convinced, in spite of all the evidence, that they could get what they wanted from England, and they transferred their inquiries and business to America at once. This tendency, whether proceeding from indifference of the buyer or lack of push on the part of the maker, should be changed.

On the general subject of foreign competition in New Zealand there is less to be said about Germany than about the United States. It is worth noting, however, that the elaborate cultivation of the market by German exporting organisations—backed by the Nord-Deutscher Lloyd—was carried on in return for a share in the import trade of the Dominion amounting to only 5 per cent. of the total. This characteristic of the Teuton of contenting himself with a small return at first in the hope of ultimate profit is one which might be more frequently imitated by the British trader.

The report, which deals with the trade of the Dominion for the year 1914, gives the following figures of imports and exports for the past three years, those for 1914 being subject to revision.

	Exports.	Imports.
1912	21,771,000	20,977,000
1913	22,987,000	22,286,000
1914	26,261,000	21,856,000

American and German Competition.

The opening of the Panama Canal has already been shown to have brought the Eastern States of America into closer touch with New Zealand. This was dramatically brought home to importers when the first direct steamer *viâ* the Canal reached Auckland in advance of the mail which carried the relative documents, and a situation somewhat embarrassing to consignees resulted. Attention has been called on more than one occasion to the serious growth of competition for trade with New Zealand which is resulting from more rapid and more frequent steamer connection between America and New Zealand. The better steamers across the Pacific to the west coast of America are inducing people to an increasing extent to treat the route across the United States or Canada as "the way home"; and it frequently happens that business men, even if they have no particular intention of doing business until they reach England, are captured *en route*. Every effort is made in America to secure the goodwill of such travellers by hospitality, and by giving facilities for seeing works and business systems. Hitherto, the slow and indirect steamer facilities from the manufacturing side of America have militated against trade with New Zealand. It may be seen at once, therefore, that the immense reduction in distance effected by the opening of the Canal is a fact which British manufacturers cannot afford to ignore. Freight rates must also be closely watched. American manufacturers have been materially assisted in the past by the preferential low rates conceded to them by British shipping companies, ostensibly in order to keep the shipping from American ports in British bottoms. Similar preferential rates have been given to goods shipped on through bill of lading from Antwerp, Bremen, and Hamburg, *viâ* London, and carried in British ships. The alternative for German merchants was to send goods by Nord-Deutscher Lloyd boats to Sydney for transhipment to New Zealand. The excessively low rates, in some cases as much as 30 per cent. less than from London, unquestionably tended to divert trade to Germany, especially in bulky cheap goods. Assisted in this way, German trade had grown to such dimensions that the Nord-Deutscher Lloyd opened offices in New Zealand in the early part of 1914, and arranged to bring their steamers right through. The first steamers were on the way when war broke out. From this, it is evident that the policy of giving low freights to German goods, while damaging to the British manufacturer, has failed to achieve the object which was its justification.

Meeting the Market.

The closing of the German market as a source of supply has called attention to the goods in demand in the Dominions, and the large number of these which have been supplied from Germany. Many are little more than cheap imitations of British makes, and in this case it is exceedingly doubtful whether it is desirable that we should lower our standard. If skilled labour is fully occupied in a particular trade, it would undoubtedly be a serious error to divert it from making high-grade goods, for which there is a good demand and less competition, to turning out low-grade articles in which the competition is severe. My own view is that manufacturers are blamed unjustly in many cases for not cheapening their goods by making a lower quality. On the other hand, they are extraordinarily obstinate when they persist in disregarding the use to which goods are put, and making them unnecessarily heavy, cumbersome, and awkward to use. The accusation against the manufacturers is that they invariably reply that what is good enough for the home market is good enough for New Zealand. If, however, the New Zealander lives and works under different conditions, and in a different way, the manufacturer is merely showing his ignorance of the fact that there is considerable variety of taste and habit in different parts of the world. When the manufacturer, further, refuses to parcel his goods and pack them as his customers require, he is simply putting himself out of the market, and deserves no assistance.

It is quite certain that the trade done hitherto in New Zealand by Germany and Austria will not drop into the British lap and stay there without deliberate effort. It may be that the present time will induce the public to make trial of, and the retailer to stock, better quality British goods, instead of Continental makes which cannot be procured. Buying agents in London and Birmingham may be forced to widen the area of their acquaintance with British manufacturers. The latter, however, must first realise that if they do not unbend and hustle, the whole trade will go to America or any other country which will meet the requirements of buyers.

Firms manufacturing for both Australia and New Zealand ought to realise one important contrast between the two markets. In proportion to its population, the latter has an exceptionally large number of more or less independent importing and exporting centres. This not only augments the number of towns for agents to visit, makes travelling expenses higher in proportion to sales, multiplies the number of firms to be dealt with in order to cover the Dominion, reduces the size of individual orders, and widens the area of and so increases the cost of advertising, but it is the most important factor in raising retail prices through the high cost of distribution.

Selling Prices.

The main difficulty in selling British goods of any and every kind is that they are almost invariably more expensive than any others. In most cases they are better quality, and in many cases they are better by much more than the difference in price; in other words, they are better value. Starting from the standpoint of unwillingness to reduce quality, which is in the main a sound attitude, Mr. Wickham says that there seem to be only two alternative courses: Either the cost must be reduced while retaining the quality, or the public must be convinced that it is advantageous to buy the more expensive goods. On these two main lines a few suggestions deduced from a study of trade methods in New Zealand may be of use. In the first place, as few manufacturers do their own shipping, the fact has not been sufficiently appreciated by them that the price of goods, which determines their sale, is not the works' cost, but the cost delivered in the consumers' market. From the point of view of the ultimate buyer, it makes not the slightest difference whether a low price is brought about by economies in manufacture or in packing, in freight or in reduction of breakage. If manufacturers are working on too small a scale to do their own shipping at rock-bottom cost, they must either depend on merchants or adopt some co-operative method which will enable them to share in a single efficient and economical selling organisation. If they do their own selling, they must realise that it is to their interest to employ as much time, brains, and energy in producing economies in the packing and shipping of goods as in reducing costs in manufacture. If their export office is not well organised and staffed they will fail to meet competition in distant markets, in spite of all the chemists and technical experts whom they may introduce in their works. In goods such as insulators, British manufacturers are beaten on price by Continental competitors, whose large scale of production lowers their costs. The Colonial habit of deferring orders, and then requiring urgent delivery, makes it important that large stocks should be carried.

New Zealanders must not be blamed for purchasing comparatively "cheap" goods. Cost of distribution makes retail prices high compared with landed costs. The retail trade makes very little effort to sell on quality. The dominating policy is to get something cheaper than competitors and to push goods solely on price. It remains to consider what, if anything, can be done by the manufacturer to promote the sale of his goods in spite of their being more costly than others.

Points to Consider.

The following are some points which may be suggestive:—

Give the agent, merchant, and retailer special inducements and adequate remuneration, bearing in mind cost of distribution, or travelling, and of living. Large margins must be allowed for commission or discount.

Study the convenience of those who handle the goods by adopting neat parcelling and labelling. This saves time and labour in distributing and retailing.

Get away from the pleasant self-satisfied British belief that everyone in the world wants British goods. Take the trouble and go to the expense of making them known and wanted. Call in the assistance of a good local advertising expert, and plan to stimulate demand.

Demonstrate to the New Zealand purchaser that British manufactures are good value, whilst the foreign are merely cheap substitutes, and bad value at the price. To do this send consignments, after consultation with an agent, and arrange for them to be displayed.

Let the manufacturer come out and go round with his agent in order to learn the difficulties of selling, and what technical information will be of use to his agent.

Mr. R. W. Dalton, who, as already announced in our pages, has been appointed to succeed Mr. Wickham as H.M. Trade Commissioner in New Zealand, has had many years' experience in the Board of Trade Commercial Intelligence Branch, and his activities in that department have acquainted him very thoroughly with the abilities and characteristics of British manufacturers. We have good reason for speaking highly of Mr. Dalton's qualifications to efficiently fill the important office to which he has been appointed. He is no stranger to electrical and engineering matters, and we do not doubt that in him our firms will have both a staunch champion and an intelligent critic.

REVIEWS.

Modern Illuminants and Illuminating Engineering. By L. GASTER and J. S. DOW. London: Whittaker & Co. Price 12s. 6d. net.

There are now many works dealing with the subject persented by the authors, but the matter before us is treated in a very different manner to any of the other English books which we have seen. It would appear, however, to be modelled to a large extent upon the lectures in Illuminating Engineering delivered at the Johns Hopkins University. We are of the opinion that the writers have been mistaken in attempting to work on such broad lines, and the reader who is on the look-out for a good practical work is apt to be disappointed.

In their preface the writers state that their aim has been to bring together matter not usually available in a single volume, and there is no doubt that they have succeeded admirably from this point of view. They also make a further apology for not entering deeply into details, and they draw attention to the large number of references which enable readers to refer to the original papers for fuller information. Here, again, we have nothing but praise for the immense amount of work which has been carried out, but there are very few who take up this book who will be able to find time to refer to many of the sources of information, even were they able to get at them, since there are very few libraries which collect technical papers such as those referred to.

With regard to the actual production of the book itself, we are pleased to see that anti-glare paper has been used. This, together with the fact that the type itself is very clear, adds greatly to one's comfort in reading such a volume; but we are very disappointed at the illustrations, which are largely reproductions of what has previously appeared in the technical Press.

The first chapter contains a sketch of the history and development of methods of illumination, and, while the reading of this is no doubt of considerable interest, we do not think that its inclusion was absolutely necessary. In the first pages there are several facts which are, apparently, contradictory to accepted ideas regarding the introduction of various illuminants. The latter part of the chapter deals with the trend of modern development, and is of rather more service. The authors next deal with gas lighting, and this portion will no doubt be of considerable interest to electrical engineers. It is in this chapter that we note the laxity of the authors in speaking of candle-power. This criticism applies not only here, but also to subsequent chapters, and indicates a slavish copying of published information without the editing of the details.

The next chapter treats of electric lighting, and many of the remarks contained therein are of extreme interest. One notes that the statements contained in this chapter are generally more precise than those in the chapter relating to gas lighting, and there is also evidence that there has been a certain amount of editing so far as the claims put forward by manufacturers are concerned. A considerable number of pages are devoted to the subject of vapour lamps, details of which are usually somewhat difficult to obtain.

Oil, petrol air gas and acetylene lighting are next dealt with. The information given should be of considerable assistance to those whose duty it is to advise concerning country house lighting and other installations where an isolated plant may be required.

The two following chapters should be of very great use to those who desire to study the physical side of illumination, and, except in the lectures referred to above, we have not seen the physiological side treated so fully. The table indicating the intrinsic brilliancy of various illuminants would have been better had it been brought up to date and the more modern light sources tabulated therein. Much of the information given regarding the effects of coloured light is not generally known, and illuminating engineers would do well to carefully consider the remarks dealing with this portion of the subject. We are inclined to think that this section has been greatly neglected in the past, and this neglect is no doubt responsible for the many light-wasting devices which are on the market, and it is only by a thorough understanding of the facts put forward in these two chapters that one is enabled to appreciate the reasons for good lighting to the fullest extent.

The authors next deal with the measurement of light and illumination, and, while the fundamental laws are carefully set forth, we think that there is room for improvement; in some of the more elementary works we have noticed that the essential facts and formulæ have been more clearly defined. The description of essential instruments is very brief; it would have made the book better and of greater use had the authors dealt with the matter completely.

While appreciating that colour photometry is somewhat difficult to those not used to the work, we are inclined to think that far too much attention is paid to it, and the large number of pages devoted to it in the present work are quite unwarranted, especially in view of the more important matters omitted.

Chapter VIII is devoted to globes, shades and reflectors, and calculation of illumination, and while we recognise that the authors have endeavoured to be impartial, it is strange to find

so much reference to prismatic glassware. We do not think that practical illuminating engineers will find much information which will be of assistance to them in this or the following chapters. The lighting calculations are but few, and data relating to indirect and semi-indirect lighting, which one would expect to find, are missing. We certainly share the view expressed by the authors that the lighting expert should thoroughly understand architectural style, and study how the architectural and artistic aspects of the problem can best be reconciled.

The following chapter is devoted to the problem of interior illumination. After some simple rules for good lighting, there follows a table showing the specific consumption for various systems. This table in itself is incomplete and is not at all up-to-date; following closely there are somewhat rash statements regarding the intensities of illumination usually found. The table of maximum foot-candle intensity is very brief and could be extended with advantage. A discussion on shadows and direction will be read with interest. Local and general lighting are next treated, and peculiar statements regarding the sub-division of units in a large room are to be found under this heading. Much attention is paid to domestic lighting, and school lighting, too, is treated very fully. The pages devoted to industrial lighting are generally good, but comparatively few data which would be of service are given. The illustrations of installations in this section are relatively poor and are open to much criticism. A few paragraphs regarding the lighting of buildings for large gatherings are next presented, shop lighting and illumination for games played under cover are dealt with, and the chapter closes with a few paragraphs relating to decorative and spectacular lighting.

The final chapter is devoted to outdoor lighting, and is very largely a résumé of papers and discussions, particulars of which have appeared in the technical Press. The book closes with an appendix indicating the works dealing with illumination, most of which are referred to in the text.

As a book dealing with generalities regarding lighting and illumination, there is every reason to congratulate the authors upon the admirable collection which they have made, although there are many statements, which those who have had actual experience will know cannot be justified in practice. We believe that much has been written which could have been left out with advantage, and, correspondingly, more data could have been included without making the work a highly mathematical treatise. If the authors could see their way to publish a supplementary book embodying the features indicated, we think that it would be met with general approval.

A Treatise on the Theory of Alternating Currents. By Alexander Russell, M.A., D.Sc. Vol. I, Second Edition. Cambridge: University Press. Price 15s. net.

Readers who are interested in the mathematical theory of alternating currents need no introduction to Dr. Russell's treatise, which has occupied a definite and well-merited place as an authoritative work of reference for the last ten years.

As in the case of several other works involving a great amount of labour, the call for a revised issue of the first volume has had to be met before the completion of the second volume has been accomplished.

According to the original plan of the author, the first volume contains the more general theorems of the subject of his treatise, while the second volume is to include matter more directly connected with the practical applications of alternating currents to industrial purposes, and will deal with the theory of alternators, motors, transformers, converters, and the transmission of power by polyphase currents.

The present edition contains a considerable amount of new matter, and this new material is of special value because of its bearing on many branches of electrical theory which are intimately related to advances in practical achievement of the present time.

A new chapter is devoted to the consideration of the self and mutual inductance of circular and helical circuits—a subject bearing on many problems of power and telegraphic transmission. In this connection, the author has necessarily referred to the important work published by the Washington Bureau of Standards.

Another important new chapter deals with high-frequency currents, and gives very fully the special conditions governing the transmission of such currents in a concentric cable. This subject will be of special interest to readers who are interested in telephony and wireless telegraphy. In Chapter IX, which is also new, the mathematical student of wireless telegraphy will find a discussion of the mutual actions which take place between two linked oscillatory circuits which should be of great value to him.

Another new chapter deals with a subject to which the author has already devoted much attention in papers presented to several Societies; this is the study of the electrostatic field between two charged spheres. In connection with problems on the design of high-tension transmission lines and insulators, the theoretical work of this chapter is again of a character to be of value to the earnest student of modern practical developments.

Dr. Russell's work will always prove valuable to the electrical engineer engaged in research or in pioneer work, where the theory of physical phenomena has to be reduced to mathematical symbols, and we, consequently, welcome the present enlarged issue of his important work. It is no adverse criticism to say that his treatment of the many problems with which he deals is primarily that of a mathematician and not of an engineer. He offers valuable material for the engineer to work upon.

We trust that the completion of the author's plan by the issue of the second volume of the *Theory of Alternating Currents* may not be long delayed.

Standard Handbook for Electrical Engineers. Edited by F. F. Fowle. Fourth Edition. London: Hill Publishing Co. Price 21s. net.

This volume contains 2,000 pages; the index alone occupies 68 pages, and the book is divided into 25 sections, each of which is packed as tightly with information as the editor-in-chief and his large staff of specialists—many of whose names are of world-wide reputation—can cram it. To review such a work and to do every part of it justice would obviously require a similar staff of specialists, and would be of little service to the reader after all; we can only deal with it in general terms.

The last edition appeared in the autumn of 1910, and was reviewed in our pages in 1911; it consisted of some 1,500 pages. The "total issue" was then 19,000; now it is recorded on the title-page as 35,000. No better testimony could be given as to the position it has attained in the electrical engineering world since its first appearance in 1907.

Five years is a long period in modern engineering, and therefore it has been necessary not only to enlarge and revise the contents, but in many cases to rewrite sections completely; at the same time the sections have been re-arranged on an improved system, with carefully selected subheads in bold type, bibliographies have been added, as well as numerous references in the text to sources of more detailed information, and many new sections have been introduced.

Any attempt to examine the contents of a section too closely usually results in the reviewer's attention becoming absorbed in the subject there discussed, a disastrous occurrence in view of those 2,000 pages and the limitations of human longevity. We must content ourselves, therefore, with remarking that we kept the previous edition constantly at hand, and found it extremely useful; our examination of the new one shows us plainly that it represents a great advance upon its predecessor, and that it will be an indispensable desk companion —one of those things that an electrical engineer cannot do without. That the *Standard Handbook* as a work of reference is unexcelled by any other compendium of the same kind is beyond question.

While we have not examined the work very closely for misprints, we note a couple on p. 1823, namely "Utah" for "unit" in a headline, and 6 for 9 in the value of g in the table.

The Elements of Electro-plating. By J. T. Sprague. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net.

This little book, intended as an introduction to the study of the elements of electroplating and electrotyping, is a reprint of the chapter on "Electrometallurgy" from the late Mr. J. T. Sprague's well-known text-book on "Electricity: Its Theory, Sources, and Applications." The text-book itself has for long been deservedly popular, and this extract from it was well worth separate publication to put into the hands of the experimenter beginning the practical study of his subject, or the mechanic engaged in it industrially. Indeed, it may be said that there is no existing text-book of this scope that contains so much information, put, too, in as clear and attractive a fashion as could be wished. Many an old plating-hand will find here hints and suggestions that even he will find worthy of attention.

There are, however, one or two errors; one of them on page 59 a serious one that calls for criticism. The author there writes, speaking particularly of the electro-deposition of copper, that "means have been devised to cause a circulation of the liquid, but they have mostly failed." There is probably in existence not a single modern electro-depositing plant of any magnitude, no matter what metal is being deposited, in which the electrolyte is not circulated, and it frequently happens that adequate circulation makes all the difference between commercial success and failure.

In page 110 it is recommended to keep nickel solutions slightly alkaline. That is opposed to general experience, which, on the contrary, favours a slightly acid solution, as the metal tends to strip when deposited from a neutral or alkaline bath.

The forecast on page 114 that the deposition of iron is not likely to have extensive practical application now seems likely to be falsified, for pure electrolytic iron is quite possibly going to prove of considerable industrial value.

We mention these flaws to indicate the limitations of this little manual, but nothing can detract from its extreme usefulness and remarkable fullness of information considering the tiny space into which the author has succeeded in compressing it.

SOME DIFFICULTIES OF DESIGN OF HIGH-SPEED GENERATORS.

By PROF. A. B. FIELD, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *November*, 1915.)

(*Continued from page* 766.)

Stator Construction.—We have so far dwelt upon the difficulties of rotor construction, inasmuch as these were felt to be perhaps the hardest of solution. The electrical conditions to be met in the stator are by no means easily provided for; some of them will be briefly touched upon. Reference has already been made to the high air-gap inductions and the severe way in which the annulus of stator material in the neighbourhood of the slots must be worked. The comparatively small air-gap and considerable length of the machine forbid the use of radially-disposed stator vents receiving their entire air supply from the air-gap. Some system of axial ventilation is practically imperative, and in these machines very complete axial ventilation is provided. The provision for the air supply is particularly liberal immediately behind the teeth; in fact, behind each slot are arranged three oval ventilating openings, with only a narrow strip of punching separating them from one another and from the slot; in this way the amount of core cooling surface is properly proportioned to the cross-sectional area of the air vent.

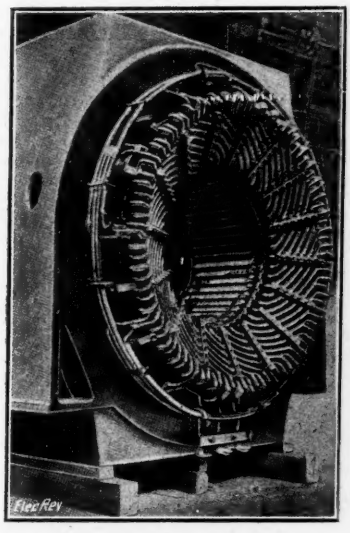
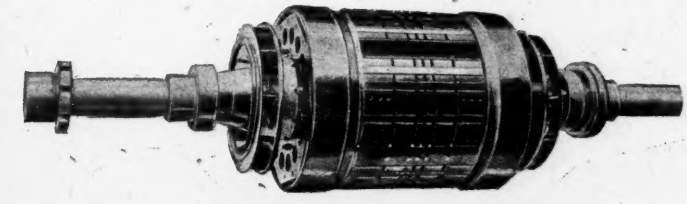


Fig. 9.

Fig. 10.—Solid Cast or Forged Rotor Construction.



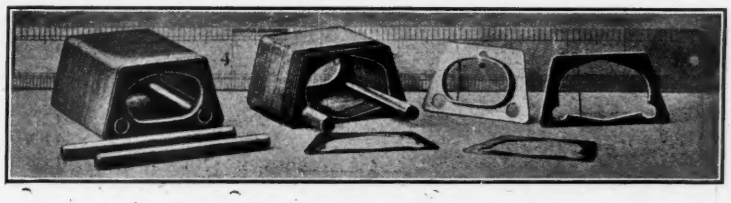


Fig. 11.

On account of the length of these machines, the cooling air is admitted at each end of the stator and discharged at the centre, avoiding the considerable difference of air temperature between inlet and outlet involved when the air is passed along the entire length of the machine. This arrangement also considerably simplifies the question of rotor ventilation. The total volume of cooling air required by such a machine is in the neighbourhood of 60,000 cubic feet per minute; and in order to accommodate these volumes a large central opening is necessary. This could be provided in the form of a number of vent ducts, but a large amount of resistance to the air flow would be occasioned by so much breaking up of the continuity of the axial air-passage. It becomes desirable, therefore, to attempt the equivalent of a single central opening. However, as it is not feasible to make any provision in the rotor for the absence of stator material at this place, a great concentration of flux is to be expected in the punchings immediately adjacent to and on each side of the central duct. Also, a great deal of stray flux from the rotor would enter these punchings at their face surface instead of at their edge. These conditions would be so severe as to cause prohibitive heating in this part of the stator if suitable provision were not made. This provision must be made in two ways: First, by properly proportioning the flux per inch of core immediately next to the vent; and second, by taking care of the large stray flux leaving the rotor from this vent zone. The stray flux can be taken care of by placing a couple of packets of punchings in the centre of the vent with the teeth cut back somewhat, the thickness of the packet being properly proportioned with respect to the increased air-gap of this part of the core, so that each packet will carry a correct amount of flux. The conditions at the end of each half of the core can similarly be taken care of by cutting back the teeth in steps, so that the air-gap is graded here to allow for the fringing effect from the rotor. In some cases it is of advantage to obtain these increased air-gaps, not necessarily by an increased inter-iron space, but by removing some of the magnetic material of the teeth themselves or immediately behind the teeth.

External Short-circuits.—One of the great difficulties anticipated from the start in the case of these large machines was the conditions arising in the case of a feeder short-circuit or its equivalent; and much discussion has arisen with regard to the advisability of using large reactance coils between the generators and their bus-bars. While a certain amount of external reactance has its use in some cases, it has been felt by some of us that these large machines should in any case be so built that they could be "dead short-circuited" at their terminals when running excited and giving full voltage. Where these units are required it is seldom of importance to have a close inherent regulation—rather the contrary. A poor regulation and a comparatively low ratio is desirable between the excitation required for full voltage at no load, and that required for full-load current on short-circuit.

In a paper read before the American Institute of Electrical Engineers, the author suggested that when a short-circuit takes place across two terminals of a 3-phase machine at the instant of zero voltage between those terminals, the maximum flux is being enclosed by the short-circuited band of conductors, and that as the rotor progresses, tending to withdraw this flux, the short-circuited stator copper maintains the flux at that time encircled, whilst the rotor also, by reason of its low-resistance circuits, maintains its own flux. The enormous short-circuit stator currents and increased excitation currents, together with the circulating currents in the body of the rotor and in the slot wedges, distort these fluxes, making each complete its circuit as best it may circumferentially through the air-gap and through whatever space is found available.

It has since been possible to obtain some confirmations of these conditions from oscillograph tests on some of these large generators. Exploring coils were threaded through the stator immediately behind the slots, to test first, the course followed by the flux encircled by the short-circuited stator copper, and secondly, that of the flux associated with the rotor. By means of two exploring coils of approximately one pole-pitch span, one of which coils has its axis coincident with the axis of the short-circuited stator copper, and the other of which has its axis displaced 90 deg. (electrical), we can trace the action during the short-circuit. From the first exploring coil we find a normal voltage wave up to the instant of short-circuit, from which time onwards the voltage generated in the exploring coil has a very small amplitude, and such voltage as arises is clearly due to high-frequency pulsations connected with slot-pitch questions. Were there any considerable 60-period changes of flux as the successive poles pass under the short-circuited copper, this exploring coil would be bound to show a correspondingly large 60-period voltage, such as is recorded immediately before the short-circuit. The second exploring coil shows the voltage produced by the stator flux which does not thread the short-circuited copper; in other words, it samples the rotor flux; and the oscillogram given by this exploring coil shows a continuity passing through the instant of short-circuit, the curve only gradually changing shape and amplitude after many cycles beyond the short-circuit point.

An appreciation of the general nature of these distortions arising on short-circuit is of some importance, indicating among other things the great gain that may be expected by providing what will be, from this point of view, an increased air-gap; that is to say, by increasing the physical distance between the stator copper and such part of the rotor (generally

very near to the surface) as is effective in carrying large currents. The author does not believe that there is much to be gained by the presence of magnetic material in the inter-space between the windings; for instance, a partial closing of the stator slots by overhanging tooth-tips would not be of appreciable benefit under short-circuit conditions. The chief requirement is more space. In the machine mentioned, this increased space is obtained by a device which became necessary owing to entirely different relations; it is obtained by the use of the laminated magnetic slot-wedge described below. The results of short-circuit tests on a 20,000-K.V.A. machine with this construction showed by oscillograph tests how effectively the maximum short-circuit current had been kept down. The maximum possible short-circuit current found at full voltage, assuming the short-circuit to occur under the worst conditions of phase, amounted in this machine to only about 14 times the maximum of the full-load current wave. In some other machines, not requiring the laminated wedge, the desired separation has been obtained otherwise.

As regards protecting the part of the winding external to the core, the means adopted in this case are believed to be more substantial than ever before used. Fig. 9 indicates the type of stator end-winding and bracing adopted, but it does not clearly show that the supporting conditions obtaining throughout the length of the core, by reason of the teeth and slots, are again reproduced in the end-windings. This is effected by means of bronze herring-bone castings placed between the two layers of the end-connection winding, the casting have fins projecting between the coils on each side of it, thus locking the two layers together and entirely providing for any tendency of the one layer of winding to shear relatively to the other. In fact, we have at every one of the 16 metal supporting brackets practically slot conditions reproduced.

Rotor Surface Losses.—It has seldom been the case in the past in turbo-generator work that with reasonable design it has been necessary to pay much attention to the question of rotor-face losses occasioned by the open stator slots. With reasonable stator slots the air-gap has been generally ample, even in spite of the very great peripheral speed of the rotor. In the present case, however, with an air-gap of only about 1 in. radially and with the very high air-gap inductions involved, great caution was needed. It happened that, in the first few machines concerned, the stator voltages were sufficiently low to enable a cautious compromise to be adopted, with a size of slot that did not appear to involve too great risks, such slot, however, being smaller than is desirable from an electrical point of view. However, some orders having been taken for machines of high voltage (such at 13,200 volts), it was obviously necessary to discard compromise and devise a means of using a large stator slot without serious rotor loss. In this connection it may be pointed out that, while for low peripheral speeds and machines of the type common in engine and water-wheel practice we have sufficient data to determine fairly well what will be a harmful configuration of slot, air-gap, air-gap induction, etc., we have not got these data for turbo-generator conditions. In the classical article* of F. W. Carter, investigating the air-gap reluctance as affected by stator slots, this author proceeded to indicate in a general way the manner in which the various factors were involved which determine the pole-face loss under certain hypothetical conditions, although the formula given was probably never intended to be a quantitative indication of the pole-face loss. According to this investigation, a figure involving the following factors should be some criterion of the amount of loss per square inch: —A factor depending upon the ratio of slot to gap, which can be most easily obtained from a curve; the square of the ratio of the rotor ampere-turns for the gap to the gap length; the peripheral speed of the rotor to the 1.5th power; and, finally, the square root of the slot-pitch. The other quantities involved may generally be considered constant from one machine to another. While it is not possible to compare, say, an engine-driven machine with a turbo-generator on the basis of this criterion, the figure has been found to furnish some kind of guide between one machine and another of similar type.

Another group of investigators having carried out experimental researches on the pole-face loss due to open slots give the factors involved as follows:—Air-gap density to index 2.5; peripheral speed to index 1.55; ratio of slot-width to air-gap to index 1.88; square root of slot pitch. This differs from the previous one chiefly in the way in which it involves the ratio of slot to gap.

This criterion may be valuable for speeds and conditions in the neighbourhood of those corresponding to the experimental researches, but, again, it cannot be applied to turbo-generator conditions on a comparative basis. Also, comparing one turbo-generator with another, the relative merits on the basis of this criterion will be quite different from those on the Carter basis. There is, in fact, room for further experimental investigation on this matter at the actual high peripheral speeds, great air-gap inductions, and other relative proportions involved in recent turbo practice.

Tests were made on the completion of the first machines in which, as mentioned above, a compromise width of stator-slot was used, this width being considered to the best of our knowledge to be just on the margin of safety. These tests indicated that we were not far off in our judgment, and while we had commenced to incur some little rotor losses, which would have been serious had the slots been larger, it was not necessary to use the semi-magnetic wedges that had been prepared as a precautionary measure for these slots. For the 13,200-volt machines a built-up magnetic slot-wedge had been devised, consisting of a group of punchings assembled between little flanged brass end-plates in sections about 3 in. in length. These wedges, which were 1½ in. thick in a radial direction, had a very light magnetic material bridging the slot and a large clear vent-space through the centre. The wedge was put in place in the slot, and a small fibre wedge of rectangular section driven between it and the coil. Fig. 11 shows the laminated wedge and the parts from which it is assembled. This device enabled us to use with a 1-in. air-gap a stator slot 1.62 in. wide, and a stator coil which could be constructed of desirable mechanical and electrical proportions; it saved the situation.

The problem of devising a stator conductor of the size required, and with the eddy-current losses kept down to a sufficiently small value, is not entirely easy. With the protection afforded against external flux by means of the magnetic wedge, there is no great objection to using a strip about ¼ in. wide across the slot, and the conductor can be built up of a number of such strips in parallel. It is usually sufficient with such a winding to have the strips insulated from one another, and arranged so that at the end of the coil the conductor is turned over in such a way that the strand which in the one slot is nearest to the air-gap takes a position nearest to the bottom of the slot when it occurs in the other half of the coil. It can easily be shown to what extent this transposition will avoid eddy-current losses, and that in the case of the present machine, where the total depth of the strands of each conductor amounts to 1.25 in., there being two such conductors in the depth of the slot, and where the active length of the conductor is a large percentage of the length of the turn, this disposition is not sufficient to bring down the loss to a reasonable figure. It therefore becomes necessary to use a slightly more complicated connection at the end of the coil. the coils being connected together strand by strand, or in groups of strands, in such a way that there is a more thorough transposition of the location of the strands in the slot. Effectively we obtain the result of a much smaller conductor with a several-circuit winding, except that this is so arranged that there is but an insignificant voltage between the several parallel conductors, avoiding the loss of space that would be entailed were we to use a multiple-circuit winding and insulate the conductors accordingly. In view of the considerable length of the machine and the somewhat severer conditions obtaining at the centre than near the ends, and also the smaller facility than usual for end-wise conduction of heat along the copper, it was considered desirable to use a stator insulation as nearly fireproof as possible, merely as a precautionary measure. For this purpose, mica wrappers were applied by machine to the coil, giving an exceedingly solid insulation, having some 70 or 80 per cent. of solid mica. Tests on coils insulated in this way, on a small section of core placed in an oven and heated by independent means to temperatures very greatly in excess of any occurring in the machine, have indicated the high heat-resisting qualities of such an insulation.

Considerations such as the above, however, bring home forcibly the fact that the difficulties that we are encountering are largely connected with the size of the conductor that we have to use, and that increasing the copper section to relieve the temperature conditions tends to introduce troubles as fast as we cure them. For instance, were it possible to use, say, a fused silica tube for stator insulation, we could immediately cut down the size of the slot copper, at the same time overcoming much of our eddy-current trouble; and we should have no reason to be alarmed, even should the central part of the active length of the conductor occasionally reach very high temperatures. The part exterior to the slot could be of twice the section or more, and the loss entailed by reason of the higher ohmic resistance of the stator winding would be entirely insignificant. Some of the characteristics of fused silica, and the recent rapid commercial development of this material, are promising as far as they go, but many obstacles to its use for this purpose remain.

In conclusion, the author acknowledges his indebtedness to the Westinghouse Electric & Manufacturing Co., of Pittsburg, without whose cordial acquiescence he would not have felt at liberty to describe these constructions.

* F. W. Carter. "Air-gap Induction." *Electrical World and Engineer*, vol. 38, p. 884, 1901.

Discussion at Leeds.

Prof. Field's paper was discussed at a meeting of the Yorkshire Local Section, at Leeds, on Wednesday last week.

Mr. W. B. Woodhouse, in opening the discussion, said he thought it was common knowledge that during the last few years progress in turbo-alternators had gone ahead of the experience of steel makers, designers, and constructors, and the purchasers of these machines had been the unwilling experimenters at their own cost. The stresses were very considerable, and in these bigger machines one was dealing with large masses of metal; they must remember that every steel forging was a casting, and the more work there was put into the metal in the shape of rolling and forging, etc., the better is was for the metal. The problem was to produce a good steel free from the curious diseases that cast-steel

suffered from. One hoped that electrical furnaces would help considerably in that direction. The plate construction was a considerable step in advance, the weakest link in that construction being, apparently, the forging of the ends and the bolts. In the present case, apparently, the stresses were not reduced below those which arose in other constructions. Building up a rotor in that way as compared with a solid rotor seemed a loose construction, despite the very heavy stress put on the bolts holding the disks together. One wondered whether under heavy stresses, such as those caused by short-circuits, accompanied by repeated heating and cooling, this construction would gradually wear the holes a little larger or permanently stretch the bolts. It would be of interest if the author would tell them what alternative constructions were possible for rotors of the size referred to in the paper, and what, in his opinion, was the limiting peripheral speed for a threaded plate design such as had proved fairly satisfactory in small machines. Another point dealt with was that of unbalanced loads in the stator windings, and he thought that was a very good one. There was an increasing tendency nowadays to put single-phase loads on 3-phase systems, and there was always the possibility that the machine might by the failure of some section of the system be wanted for a short time as a single-phase machine, and it was important that the machine should be able to stand that. The losses from the user's point of view were not so important as the question of temperature; running the machine as a single-phase machine very seriously heated up the rotor, and he knew plenty of cases where machines had burnt out due to being accidentally run as single-phase machines. At the best of times the cooling arrangements in the end windings of the rotor were bad. Even in the present construction, so far as one could judge from the figures given in the paper, the amount of cooling at the ends was not as good as on part of the coils in the ducts. That was a common fault in all these designs, and the thermo-cable as a permanent part of the machine would be a very good thing. Some years ago he asked the makers of a machine of this kind to give him thermo-cable throughout the machine, but they said it was a most unreliable thing, and finally the cable was not put in. The machine had since burnt out. He joined very heartily with the author in regard to the necessity for every machine, before it was accepted, to be submitted to a short-circuit test. He hoped that all makers would regard these tests as essential. The first cost in large turbo-alternators was a very important consideration, but the failure and breakdown of the machine on load might cause the user of the machine losses which were out of all proportion to any saving he could effect by taking a smaller machine in which the design had been forced, and one hoped, in view of the experience of past years, that both the purchaser and the manufacturer would take a rather broader view of these things, so that they would get a machine, not necessarily to give the highest test, nor purchasable at the lowest price, but a machine which was efficient and would stand up to its work.

Mr. T. Roles asked Prof. Field to state what capacity he thought 3,000-revolution machines could safely be made up to at the present time. The author dealt more in the paper with machines up to 1,800 revolutions, but a large number of machines of 50 periods were being built for 3,000 revolutions, and from what he could see himself they were limited to about 5,000 kw. He asked also the limiting size for the solid rotor on these machines, for 1,500 and 3,000 revolutions. He was very pleased that the author had mentioned the matter of running single-phase loads on 3-phase machines. Within the last month he had been called upon to take on a supply which would be single-phase up to 2,000 k.v.a., and he was wondering what effect it would have upon the machines at the Bradford station. It appeared to him that they would all have to consider seriously this question of single-phase loads, because they would get more demands in that way, and it almost seemed necessary to specify that machines should be capable of taking a large proportion of single-phase load. He was very glad indeed to notice the author's remark that it did not appear unreasonable that a purchaser should desire to see his machine short-circuited on the test floor or after erection. It had been his practice to put a clause in the specification to that effect, and when he mentioned it to some of his fellow station engineers they seemed to think he had very great temerity. It was desirable that the machines should be short-circuited preferably at the makers' works if it could be done, because if anything went wrong it was easier for the repairs to be carried out at the works. He had taken that matter up with a number of the chief makers, and it had been put to him that it was not altogether a reasonable proposition. It appeared that British makers had been putting their heads together with a view to absolutely refusing to take this test. In the case of one of the first machines they put in at Bradford, the short-circuit test was specified and would have been taken, but it was not taken at the maker's works, and at Bradford the machine short-circuited at the tank and broke down very badly. The makers were upset, and said the short-circuit was accidental, and external reactance would have to be used. This was coupled up in the case of two machines. Those two external reactances were as much a source of danger, and quite as likely to be short-circuited. He thought the machines should be so built that they could be short-circuited without external reactance.

Mr. W. M. Selvey said that only the previous week a machine had come before him with 80 volts on the rotor, and the first thing to go was the rotor, which went into flames. That was happening continually, and he could not explain it. The author anticipated high temperatures in the future, but his (Mr. Selvey's) information foreshadowed that the rotor temperature would be limited, and perhaps the suggestion which Messrs. Parsons had just patented of an internal water cooler would help matters. Steel was being made in a barbarous manner, and until the electrical engineer took up the question and made ingots of steel, he did not think there would be much advance made. If they got pure steels they could, he thought, get over a good deal of the necessity for this plate construction. In his opinion, it was just as necessary that the stator should stand up to the short-circuit test as the rotor. In running machines in parallel, it had come to his notice that the newer types of machines would not take the wattless current.

Mr. Barclay, referring to the bending of the end ring due to centrifugal force, said that in the case of a typical 5,000-kw. alternator it increased about three-hundredths of an inch, and it was seldom that one was asked to provide a ring with such an initial shrinkage that it could be kept on, with the result that it was actually floating. In the case of single-phase machines, a narrow band of manganese bronze could be introduced between the ring and the core, and the extra cost was justified by the mechanical soundness gained. An effective gap between the core and the ring might be provided, which would considerably reduce the magnetic leakage which the author had referred to, and also improve the ventilation in the rotor end windings. He understood that at the discussion in London it had been stated that no steel manufacturer would guarantee certain tests in regard to the amount of stress; that was not correct. Tests which he actually took that morning in connection with a 31½-in. diameter rotor, having a core length of 51 in., showed an elastic limit of 19½ tons, and an ultimate strength of 35 tons. A test taken on the periphery gave 20 tons elastic limit and an ultimate strength of 36.8 tons. Similar tests taken at the opposite side gave 19½ tons elastic limit and 38.4 ultimate strength. There was not much doubt that the most economical and mechanical construction was the solid forged rotor; probably the soundest construction was to have the hollow forged cylinder shrunk on to the shaft. With that construction a definite guarantee could be given for the tensile strength of the steel rotor. After the forging was made it should be annealed, and after turning re-annealed and oil-hardened.

Mr. Burnand said with regard to the 4-in. diameter bolts, which stretched as much as one-tenth of an inch on their initial tension, he did not think there was much reason to anticipate trouble, with the class of steel used. Regarding critical speed, the author appeared to recommend that this should be above the running speed of the generator, and, provided it was well above the speed of the generator, that was quite sound. The only point against this was that the higher the critical speed the more violent were the effects when they reached that speed, and that was rather in favour of the lower critical speed. While the paper showed that many difficulties had been overcome, something might have been learned if the author had given them instances of promising devices which had failed to overcome the difficulties which they were designed to counteract. He wondered whether the author had tried turbo-alternators having an armature rotating portion. There were difficulties there due to the large number of plates, but he did not suppose they were insuperable. The armature, he thought, would stand short circuits when rotating at a high velocity that it could not stand up to when stationary.

The Chairman (Mr. H. Hodgson Wright) said that the author emphasised the necessity of designing the generator for a running speed below the critical speed. If that condition was to be satisfied, the distance between the bearings must of necessity be kept as short as possible, owing to the fact that the critical speed was inversely proportional to the square of the distance between the journals. He thought it was good practice to have the running speed at least 30 per cent. above or below any critical speed. The de Laval turbine was an exceptional case; steady running had been obtained in that instance by having the running speed about seven times greater than the lowest critical speed. Nickel steel had a permeability of less than one-third of chrome nickel steel; the method of protecting the steel end ring was interesting, but rather costly. In reference to external short circuits, he thought it was generally admitted that the best engineering practice at present was against using external reactance coils. The advantages of being able to dead short-circuit the machine outweighed the disadvantages of bad power regulation; a generator which could be short-circuited whilst running fully excited, or that could be inadvertently left standing idle on the bus-bars, was one that any station engineer could put his confidence in.

The Author, replying to the discussion, said that with plough steel wire they could get considerable ductility at 125 tons to the square inch. That was giving them an ideal to aim at, which would be extremely useful to the builder if they could get that kind of material in larger pieces. The chrome nickel steel which was used for the end rings was a sample of what one could get in fairly big pieces if one paid the price, but if they built the whole rotor of high-tensile steel the cost would be considerable. The idea of using steel wire

for the end rings had occurred to several, but there were difficulties to be encountered which made it rather unpromising to tackle. A considerable number of big machines had been built with forged plates threaded on a shaft, but that was rather costly in material, and when they had to put a 10, 12, or 14-in. shaft through a rotor like that the shaft was not going to stiffen the thing at all; if it could be built the other way it was preferable to do it. There was also the alternative possibility of using the single forging; that was more or less a question of what material could be obtained. He did not say in London that steel makers would not supply these forgings, but that in the States they were not able to buy a forging to a specification that they considered satisfactory. Steel makers would willingly supply them with forgings, but if they wanted to insert an acceptance or rejection clause based upon radial tests and the ductility and elongation and contraction of area in regard to these tests, then no steel maker would take the order. It appeared that it was possible to get these in England, and if this material could be got in the large sizes, and they could get reasonable ductility, then the large forging was a reasonable construction. The end winding was the most difficult part of the rotor to keep cool. It was not possible to ventilate it satisfactorily. The total temperature rise in these windings was entirely safe from the insulation point of view; it was really the question of expansion and contraction which was going to limit them in the matter of temperature rise rather than insulation. In the States they rated machines upon their maximum continuous output, and in England they were in the habit of calling for continuous overloads, so that what one might call at 5,000-K.V.A. machine would perhaps be more nearly 6,000 K.V.A. on the basis of the paper. Short-circuiting at the works in some cases might damage the machine; the final puncture test should be taken the very last thing, so that if any damage was done to the winding it would show up on the puncture test. Deformation of the end ring certainly occurred with an increase of the temperature, and when the machine got up to high speed there was usually a distortion of the ring due to the asymmetry of the windings. The ring expanded with temperature and changed from a circle to a more or less elliptical figure. It was not possible to put these rings on with such initial tension that they did not rise off their seat. The question was raised why so much trouble arose on the rotor, with a low voltage as compared with the stator; the trouble was not a matter of voltage, he was afraid; it was a mechanical trouble. Trouble had also arisen due to dirt accumulating, and he did not think the trouble had been any greater on 250-volt rotors than on 120-volt machines. One speaker asked why they had elongation in the material for the rotors. He thought they needed a ductile material capable of suffering a certain amount of elongation for several reasons. In the first place, they knew that in turning out these big machines in the shop they got all sorts of shop accidents. A tooth would get bent. There were heavy pieces to handle, and they were not always dealt with as carefully as they might be. Again, they knew it was not possible to get the effects they looked for. When the machine was actually run the wedge, which was supposed to distribute the stress properly along the length of the tooth, held in one or two places and gave local stresses. They needed ductility from various points of view. It was the tangential stress and radial stress they had to take care of. He fully realised the importance and advantage of cleaning and washing air, but in the States there had been, until recently, a great opposition on the part of operating engineers, because it was a nuisance and they did not want to be bothered with the matter. The rotor insulation was mica everywhere. Even in machines with 220 volts or so, the copper edge-winding was quite thick, something like one-tenth of an inch, and it was not hard to edge-bend. He had seen the machine bend coils 15 mils thick by about 7½ in. wide. Each segment had two dovetails in the frame, and they took the extra precaution of insulating the core from the frame; they did not gain a great deal in reduction of core loss by doing that. Just how much variation one could allow in stress was a matter which had been the subject of a great deal of investigation. In the present case the stress was something like 4,000 lb. in the steel bolts, and the range of stress on the rotor was less than 1,000 lb. The total range of stress even on the bottom of the thread was less than the safe limit for an indefinite number of reversals. With regard to expansion, the tenth of an inch was elastic expansion; it was not a stretch. The point raised in the paper was not that they could not get the tensile strength radially, but they could not get ductility. In reply to the Chairman's remarks, he said that machines had been built of 10,000 K.V.A. at 1,500 R.P.M. with self-contained blowers, and it was simply a matter of balancing up the advantages and possibilities. Personally, he thought in big machines there were considerable advantages in using separate blowers, particularly when they came to modern stations in which the ventilating system could be thought out in advance and they could get a proper intake duct running the whole length of the station, and outlet duct and filtration plant, etc.

Colombia.—H.M. Minister at Bogota says that electric light fittings and shades are among the goods hitherto supplied by German firms that are in demand there.—*Board of Trade Journal.*

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,780. "Switches for electric cycle lamps." F. Westwood. November 29th. (Divided application on 7,909/15. May 28th.)

16,781. "Electric generator or motor." W. H. F. Murdoch. November 29th.

16,797. "Casings for portable electric flashlights." E. C. R. Marks (Interstate Electric Novelty Co., U.S.A.). November 29th. (Complete.)

16,814. "Electric steel and alloy making and refining processes." J. R. Hyde. November 30th.

16,817. "Body warming electrical apparatus." M. H. Goldstone. November 30th.

16,836. "Electro-magnetic driving or transmission gear." A. A. Canton. November 30th. (Complete.)

16,846. "Electric switches." E. T. Brook & O. H. Bishop. November 30th.

16,853. "Terminals for the flexible cables of medico-electrical apparatus." E. E. Lakin. November 30th.

16,854. "Dynamo-electric machines of the commutator type." M. Walker. November 30th.

16,865. "Portable electric lamps." V. C. H. Gibson & E. G. Benns. November 30th.

16,866. "Hunting or copying switch arrangements, and electrical range-finding systems embodying such arrangements." G. L. Conner. November 30th.

16,898. "Alternating-current motor-starters." O. Ellefsen. December 1st.

16,900. "Cables for the distribution of electrical power." J. H. Bowden and H. F. J. Thompson. December 1st. (Divided application on 4,585/15. March 24th.)

16,915. "Spur gearing." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 1st.

16,928. "Dynamo-electric machines." E. Girardeau. December 1st. (Addition to 16,107/15. Convention date, December 2nd, 1914, France.) (Complete.)

16,933. "Rotary converters." O. H. Piefer & A. F. Piefer. December 1st. (Complete.)

16,934. "Intercommunication telephones." F. T. Jackson. December 1st.

16,990. "Sparking plugs." V. Perrett. December 2nd.

16,992. "Electrical signalling systems or annunciators, chiefly for hotels." International Electric Co., Ltd., & R. G. le Noir. December 2nd.

16,993. "Switches." International Electric Co., Ltd., & R. G. le Noir. December 2nd.

16,994. "Electrical heat radiators." A. F. Berry. December 2nd.

17,000. "Audible signal devices." International Electric Co., Ltd., and R. G. le Noir. December 2nd.

17,008. "Electric starters for internal-combustion engines." B. Brooks and W. Holt. December 3rd.

17,022. "Electric furnaces." Aktiebolaget Elektriska Ugnar. December 3rd. (Convention date, December 16th, 1914, Sweden.) (Complete.)

17,033. "Electric lamp fittings." A. G. Deller. December 3rd.

17,034. "Means for laying and collecting field telephone wires." A. C. G. Smith. December 3rd.

17,060. "Connection between electric incandescent lamps and holders." S. Fildes. December 4th.

17,062. "Electric furnaces." H. A. Greaves & H. Etchells. December 4th

PUBLISHED SPECIFICATIONS.

1914.

7,692. Contact-breaker Device for Electromagnetic Vibrating Members. A. H. Maitre & V. H. G. Martin. March 26th.

22,437. Arc Incandescent Electric Lamps. E. A. Gimingham. November 12th.

22,550. Electrical Heating Unit, and method of manufacture thereof. A. N. Macnical. November 14th.

22,715. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. (formerly known as Betulander Automatic Telephone Co. and W. Aitken). November 18th.

22,720. Apparatus for Heating and Sterilising Liquids. British Electric Heater Co. & C. Kratt. November 18th.

22,867. Electrolytic Cells. H. C. Jenkins, F. F. Pattinson & R. Wellesley. November 21st.

22,931. Method of manufacturing Electric Condensers. Galvanophorenwerke (System Vogt), S. Szubert, Kommanditgesellschaft & Vereinigte Elektricitatswerke Ges. November 23rd. (November 22nd, 1913.)

23,282. Telephone Hand Sets or Instruments. Automatic Telephone Manufacturing Co. (Automatic Electric Co.). November 30th.

23,292. Electrical Process for Producing Cyanides. J. E. Bucher. November 30th. (June 25th, 1914.)

23,676. Electrical Heating Elements. F. S. Grogan. December 7th.

24,108. Controllers for Electric Motors. Pickerings, Ltd., and J. Fothergill. December 15th.

24,631. Electric Insulators. Soc. Ceramica Richard-Ginori. December 24th. (April 30th, 1914.)

1915.

569. Electrical Steering and like Gear. Harland & Wolff, Ltd., and H. H. Bentley. January 13th.

1,404. Controlling Dynamo-electric Machines Running at Varying Speeds. H. F. Foster & Sharpe. January 28th.

1,671. Protective Apparatus for Dynamo-electric Generators. W. T. Tallent-Bateman. February 2nd.

2,928. Electric Light Fittings or Brackets. E. R. Hough & L. Harrison. February 23rd.

3,502. Induction Motors. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 4th.

7,206. Electric Starters for Internal-combustion Engines. A. H. Midgley & C. A. Vandervell. May 13th.

7,675. Manufacture of Electric Cables. W. F. Smith. May 22nd. (May 23rd, 1914.)

10,133. Process for the Electrolytic Deposition on all Metals of Aluminium, Tin, Nickel, Copper, Zinc, Iron, Steel, or Alloys thereof. P. Marino. July 12th.